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# THE PURCHASE AND USE OF W.A. FODDERS FOR SHEEP DURING DROUGHT.*

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The drought now raging in the pastoral districts is the most serious which has been experienced since the development of this great wool-producing area. The losses due to it are colossal, first as the result of a serious diminution of the national income, and in the second place to the ruin, or partial ruin, of individual pastoralists. It is doubtful whether any other single phase of industrial activity would have a greater detrimental influence upon the State's prosperity.

Definite statistics regarding losses are not available, but already more than two million wealth-producing sheep must have been lost in this catastrophe. The total loss cannot be calculated solely from the number of sheep lost. Great as is this loss due to the serious death-rate, it does not indicate how great it is; its most serious aspect is that the losses include so many breeding ewes which, when the drought breaks, as it will break, will be required to build up the flocks again to the normal carrying capacity of the area now affected. Some of these ewes are the result of long years of selection, and their immediate replacement, on the breaking up of the drought, is therefore impossible. Any reasonable means of saving them is thus obviously justified.

Usually, the most practical method of doing so is to transport them to more favoured districts. The resources of this plan are limited even in a normal time and are now exhausted. The only method which remains is that of hand-feeding. It is, therefore, essential, by the use of economical rations, to exploit to the utmost this method of saving the remaining ewes. The rations which will be discussed are based upon the conviction that it will be more economical to feed the ewes a better ration than one just good enough to keep them alive, and to make it sufficiently good to enable the ewes to be mated and bear a lamb; a reasonable expectation being that the resultant lambing will more than compensate for the extra cost of the additional feed.

In the selection of a suitable ration, the physiological requirements of an animal have first to be considered. Sheep, unlike horses or swine, but like

* By the courtesy of the Australian Broadcasting Commission an abridgment of this article was broadcast on Tuesday, 8th December, 1936.

cattle, have a large stomach capacity and, therefore, are adapted for the profitable consumption of bulky and coarse fodders, and under normal conditions it is desirable that their daily ration should be reasonably bulky.

Experiments conducted at the Chapman Research Station nearly 20 years ago have shown, however, that the sheep is very adaptable in this connection, and that rations consisting entirely of bulky hay on the one hand, and concentrated oat grain on the other, could be used satisfactorily. These results have been confirmed by the experience at the Meckering Research Station during the past three years. In view of this, the choice of an economic sheep ration for drought conditions will, therefore, depend upon the relative nutritive value and costs of the different fodders available, but, and this is important, it is necessary also to consider the effect of a disturbance of the market upon the cost of any particular fodder as the result of an abnormal demand for it.

Of the fodders on the West Australian market, wheat grain is the one least likely to be effected by any local demand, as its price is governed by its export parity, and its production is not only much in excess of the normal local demand, but also in excess of any special local demand likely to be made upon it. Because of this, and because of the success which has attended its use recently at the Meckering Research Station, it is very suitable as a basis for comparison with other fodders.

Having regard solely to their total nutritive value, as measured by their ability to produce energy, and not to those special properties which any of the fodders discussed may possess, the following quantities of fodders on the W.A. market may be regarded as having approximately equivalent feeding value:—

| | |
|---|---|
| Wheat grain .. .. .. .. .. | 37 bushels |
| Linseed cake or nuts .. .. .. .. | 20 cwt. |
| Oats .. .. .. .. .. .. | 65 bushels. |
| Bran .. .. .. .. .. .. | 1⅔ short tons. |
| Molasses .. .. .. .. .. .. | 31 cwt. |
| Cereal hay .. .. .. .. .. | 40 cwt. |

It will thus be seen that approximate equivalent nutrient material is supplied by about 37 bushels of wheat (1 ton) as is supplied by 2 tons of hay.

Apart, however, from the total nutritive value which these foods possess, some of them have special characteristics; for instance, linseed nuts and bran are laxative and, compared with the other fodders, contain unusually large quantities of protein. Linseed nuts and bran are mainly valuable as sources of protein and contain respectively 30 per cent. and 16 per cent., compared with 11 per cent. in wheat, 9 per cent. in oats, 6 per cent. in hay and none in molasses. Meat meal and bacal nuts (made from cotton seed meal) are other fodders with high protein content. The former is the cheapest source of protein on the W.A. market.

Protein is essential for the repair of waste tissues, the production of young animals, milk and wool. Heavy-milking animals, therefore, require large amounts. Linseed nuts and bran are mainly valuable and suitable for heavy-milking animals.

During maintenance only, when little work is done, and the animal neither gains nor loses weight, the amount of animal tissue destroyed is not great and, in consequence, the amount of protein required is small. Similarly, when the production of wool or new material is not great the protein requirement is also relatively low. For such animals the food required is mainly carbonaceous, that is, suitable for energy production, in order to provide the necessary energy for digestion and other functions, and to enable the animals to move about.

To feed fodder rich in protein—which is costly—to sheep for maintenance or low production is, therefore, extremely uneconomic. For this purpose good hay (if available at economic rates), wheat, or oat grain, is more suitable, as these fodders contain protein in amounts sufficient for the purpose, and are much cheaper sources of the energy requirements of maintenance or for low production. Molasses is a carbonaceous fodder and, like linseed and bacal nuts and bran, is also laxative. Owing, however, to its laxative character, it cannot be used in sufficient quantities to supply all the energy requirements of the animal. It is mainly used to render palatable such coarse fodders as straw and cocky chaff. Owing, however, to its deficiency in protein, it is quite unsuitable as a supplementary feed for such fodders which are also poor in protein. A very much more suitable supplement than molasses for straw, or even hay, would be bran, linseed cake, or linseed nuts. To mix molasses with hay—which should be palatable of itself—is, however, like "taking coals to Newcastle," as it is adding more carbonaceous energy (or heat) producing material to a food already well supplied with this. For practical reasons, therefore, molasses is quite unsuitable for drought feeding in the pastoral areas.

The cost of transport has an important bearing on the selection of fodder for drought conditions in the pastoral areas, as transport costs to stations are heavy, and these transport costs may actually out-weigh any advantages originally possessed by a fodder with regard to prime cost. Assuming the transport cost to be £4 12s. 6d. per long ton (the actual cost to a well-known station in the middle Murchison district), and with wheat at 4s. 6d. and oats at 3s. per bushel; with linseed nuts at £11 10s. and bran at £6 15s. per short ton; with molasses at £8 5s. and wheaten hay at £6 15s. per long ton, the cost to the nearest shilling of the different fodders, each supplying approximately the same food value, will be—

| Fodder. | | Prime Cost. | Transport at £4 12s. 6d. per ton. | Total Cost to nearest Shilling. |
|---|---|---|---|---|
| Wheat— | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| | 0 4 0 per bushel | 7 8 0 | 4 12 6 | 12 1 0 |
| | 0 4 3 „ | 7 17 3 | 4 12 6 | 12 10 0 |
| 37 bushels ... | 0 4 6 „ | 8 6 6 | 4 12 6 | 12 19 0 |
| | 0 4 9 „ | 8 15 9 | 4 12 6 | 13 8 0 |
| | 0 5 0 „ | 9 5 0 | 4 12 6 | 13 18 0 |
| Oats— | | | | |
| | 0 2 10 „ | 9 4 2 | 5 8 0 | 14 12 0 |
| 65 bushels ... | 0 3 0 „ | 9 15 0 | 5 8 0 | 15 3 0 |
| | 0 3 2 „ | 10 5 10 | 5 8 0 | 15 14 0 |
| Linseed Nuts— | | | | |
| 20 cwt. ... ... | 11 10 0 per short ton | 12 17 6 | 4 12 6 | 17 10 0 |
| Bran— | | | | |
| 1¾ short tons ... | 6 15 0 „ | 11 5 0 | 7 14 0 | 18 19 0 |
| Molasses— | | | | |
| 1 ton 11 cwt. ... | 8 5 0 per ton | 12 15 9 | 7 3 0 | 19 19 0 |
| Hay— | | | | |
| | 4 0 0 „ | 8 0 0 | 9 5 0 | 17 5 0 |
| 2 tons ... ... | 5 15 0 „ | 11 10 0 | 9 5 0 | 20 15 0 |
| | 6 5 0 „ | 12 10 0 | 9 5 0 | 21 15 0 |
| | 6 15 0 „ | 13 10 0 | 9 5 0 | 22 15 0 |

It will be seen that wheat grain is the cheapest and wheaten hay the dearest fodder at present on the local market. For the same quantity of total nutrients in a ton of wheat at the rates quoted wheat will cost £12 19s. and hay £22 15s., a difference in favour of wheat of £9 16s.

Experiments at the Chapman Research Station 20 years ago showed that lambing ewes were kept in a healthy condition on about two-thirds of a lb. of oat grain and one-third of a lb. of oat straw per day, and in a thriving condition on about one lb. oat grain and one-quarter lb. oat straw. In both cases no

other food was available. Experience last year at Meckering confirmed this, with ewes whose average live weight in December was about 80 lbs., which lambed about the middle of May, and which more than maintained their weight with a daily ration of one-half lb. of wheat and with such grazing as they could obtain in the paddock. A similar lot of ewes did equally well on oats (about three-fifths lb. of oats per day), providing equivalent nutrients and with similar grazing in the paddock. The grazing available in the paddocks, even in the early part of the summer, consisted of poor, dry feed, and could only be classed as fair; towards the end of the season it was very poor indeed, so much so that the sheep living entirely on this so-called grazing lost so much weight and became so low in condition that they had to be hand-fed; otherwise they would have died.

Departmental experiments, as well as experience elsewhere, show that pregnant ewes can be kept in reasonable condition, and without ill effects, on about one-half lb. of wheat per day, or on other suitable fodder providing approximately equivalent nutrients, such as three-fifths lb. oats or one lb. wheaten hay.

In the case of concentrated foods, like wheat and oat grain, any additional roughage which the sheep can pick up will be advantageous, not so much for its food value, but to provide the bulk which is desirable to secure the optimum digestion.* Having regard to these facts, it is suggested that the most economic ration to feed to the sheep would be about one-half lb. of wheat per day.

A mixture of two fodders is always better than one, and, as the nutritional cost of oats is not much greater than that of wheat, a better ration than either wheat or oats alone would be a mixture of both. In view of the fact that purchases of fodder for drought conditions would not disturb the wheat market as it would that of oats, it is suggested that wheat should provide the bulk of the ration, and that the mixture should be at the rate of three parts of wheat and one part of oats. Equivalent daily rations of wheat, oats and a mixture of wheat and oats, together with cereal hay for comparison, for 1,000 sheep will, therefore, be:—

(a) Wheat grain 500 lb., or
(b) Oat grain 600 lb., or
(c) Wheat grain 390 lb., 130 lb. oats.
(d) Cereal hay 1,000 lbs.

The relative costs of these rations, allowing £4 12s. 6d. per ton for rail and cartage to the property, for 1,000 sheep for one month (30 days) would be—

| | £ s. d. | £ |
|---|---|---|
| (a) Wheat—Prime Cost at | 0 4 0 per bushel ... ... ... | 81 |
| „ „ | 0 4 3 „ ... ... ... | 84 |
| „ „ | 0 4 6 „ ... ... ... | 87 |
| „ „ | 0 4 9 „ ... ... ... | 90 |
| „ „ | 0 5 0 „ ... ... ... | 93 |
| (b) Oats „ „ | 0 3 0 „ ... ... ... | 105 |
| (c) Wheat— „ „ | 0 4 3 „ ... ... ... | 88 |
| Oats— „ „ | 0 3 0 „ ... ... ... | |
| (d) Hay— „ „ | 6 15 0 per ton ... ... ... | 152 |

It will be noted that when a wheat (4s. 6d. per bushel) ration is compared with one of hay (£6 15s. per ton) there is a difference of £65 per month in favour of wheat.

* It should be pointed out that the horse, because of its relatively small stomach, is not as well adapted as sheep to deal with bulky foods, and though an idle horse will live on hay alone, a working horse needs a concentrate supplement in its ration. In the pastoral districts, where transport costs are heavy, the ration for working horses should consist largely of grain. Oats are very suitable under normal conditions, but, where oats are more expensive, some wheat can be used economically. By introducing wheat gradually into the ration it has been found that for heavy horses 9 lbs. daily can be used with good results.

Reduced to a weekly rate per sheep the costs would be—

| | £ | s. | d. | | | | | |
|---|---|---|---|---|---|---|---|---|
| (a) Wheat at | 0 | 4 | 0 | per bushel | ... | ... | ... | 4·54 pence. |
| „ | 0 | 4 | 3 | „ | ... | ... | ... | 4·70 „ |
| „ | 0 | 4 | 6 | „ | ... | ... | ... | 4·87 „ |
| „ | 0 | 4 | 9 | „ | ... | ... | ... | 5·04 „ |
| „ | 0 | 5 | 0 | „ | | | | |
| (b) Oats at | 0 | 3 | 0 | „ | ... | ... | ... | 5·88 „ |
| (c) Wheat at | 0 | 4 | 3 | „ | ... | ... | ... | 4·95 „ |
| Oats at | 0 | 3 | 0 | „ | ... | ... | ... | |
| (d) Hay at | 6 | 15 | 0 | per ton | ... | ... | ... | 8·50 „ |

When fed to sheep wheat should be whole and not crushed; at the Woburn Research Station (England) wheatmeal was found unsatisfactory owing to the fact that the meal adhered to the jaws of the sheep when eating it, forming a sticky mass. Whole wheat was substituted, and the effect was remarkable; the sheep which would barely clean up the half lb. allowance of wheatmeal readily ate three-fourths of a lb. of whole wheat.

The rations have been suggested without making appreciable allowance for any feed on the station. It may be possible to economise somewhat by the judicious use of cut mulga. The ration is also intended for mated ewes and could be undoubtedly lowered if the ewes were not mated, and it was only desired to keep them without losses. It is further suggested that the ration be considered as an average one, feeding smaller amounts from about mating time and gradually increasing towards the end of pregnancy, as would be indicated by a careful observation of the sheep. This ration would be quite insufficient for lambing ewes under severe drought conditions, and under such conditions the addition of cut mulga, linseed nuts or bran would be essential.

It must be pointed out that, whilst one-half lb. of wheat would keep the ewes in a thrifty condition until they had lambed, it would be insufficient to meet the requirements of a growing lamb, and for this reason it may be advisable to delay mating until, say, the middle of January. This affords a longer time for the drought to break and for the rains and feed to arrive before lambing commenced. This would obviate the very heavy feeding which would be necessary if the ewes were lambing without natural feed available and overcome the practicable disabilities and probable losses associated with such a procedure.

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# THE SOILS OF THE ESPERANCE PLAIN.

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and
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## INTRODUCTORY.

The central southern coastal plain of Western Australia, as exemplified by the Esperance neighbourhood, consists of a fringe of coastal aeolian limestones and sand, some four to five miles wide, rising abruptly to a plain with an elevation of from 200 to 600 feet above sea level. This elevated plain is slightly rolling, and slopes towards the coast. It is approximately 25 miles wide north of Esperance, but at Hopetoun, it is only 10 to 15 miles in width and seems to be of a more sandy nature.

On the north it gives way to the "mallee" soils at Scaddan where the elevation is 700 feet above sea level. The "mallee" soils of the Scaddan area consist chiefly of greyish, calcareous, solonised soils, and are in marked contrast with the soils of the Esperance plain.

The soils of the Esperance plain are typically grey siliceous sands with a ferruginous gravel or gravelly clay subsoil. Where the sandy surface is shallow—from a few inches to a foot deep, a layer of loose ferruginous gravel is encountered in the upper subsoil, but where the sand horizon is deep this loose gravelly layer is often absent and the subsoil is the typical yellowish red and grey mottled clay with soft ferruginous gravel. This subsoil is of importance as a reservoir for moisture and as a means of retarding the leaching of fertilisers and plant nutrients.

Although the soils are highly leached they are only slightly acid in reaction. This is probably associated with the absence of marked humus horizon. Rapid mineralisation of organic matter favours the formation of soils of a more nearly neutral reaction than in typical podsolisation. It is considered, therefore, that these soils belong to the so-called lateritic group of soils represented in the southern parts of Western Australia by the "sandplain" soils of the drier areas and the "jarrah" soils of the wetter districts. Calcium carbonate, typical of the contiguous "mallee" soils, has been removed from the subsoil and in place of it are the ferruginous concretions popularly known as laterite.

The plain is served by few definite drainage channels and the bulk of the excess water apparently drains to the paper bark (*Melaleuca pubescens*) swamps of the depressions and thence escapes by underground drainage. Where drainage channels or "rivers" have formed, the country rock, a gneissic granite, is exposed by the erosion of from 30 to 50 feet of lateritic material. This rock normally gives rise to a brown earth type of soil and is associated with a woodland vegetation quite distinct from the heath of the plain.

The native vegetation of the plain is of the heath type, low shrubs predominating. Larger plants and small trees such as chittick (*Lambertia inermis*), Christmas tree (*Nuytsia floribunda*), banksias (*Banksia media, B. speciosa*) and blackboy (*Xanthorrhoea Preissii*) occur scattered and in groves. Stunted eucalypts are common and the most common species include tallarac (*Eucalyptus tetragona*), *E. tetraptera, E. incrassata, E. angulosa* and *E. uncinata.*

The swamps carry a dense timber formation, chiefly paper bark (*Melaleuca pubescens*) some 30 feet tall, with an undergrowth of shrubs, including *Chamaelaucium axillare, Melaleuca thymoides,* etc.

In the shallow valleys where the country rock is exposed a woodland formation has been established. Yate (*Eucalyptus occidentalis*), black wattle (*Acacia saligna*), tea-tree (*Melaleuca cuticularis*) and giant zamia (*Macrozamia Dyeri*) with a variety of shrubs and grasses constitute the chief members of the vegetation.

The climate is of the Mediterranean type: wet and cool during the winter months, and warm and dry in the summer time. The summer temperatures are tempered by the influence of the southern ocean. The average annual rainfall ranges from 25 inches at Esperance to nearly 17 inches on the northern limits at Scaddan. Climatic data are given in Table 1.

TABLE 1.

CLIMATIC DATA FOR ESPERANCE (S. 33° 50′, E. 121° 55′).

(*C.S.I.R. Pamphlet* 42, 1933) *and Scaddan.*

| | Jan. | Feb. | March. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Mean Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Esperance. | | | | | | | | | | | | | |
| Rainfall (points) ... (47 years records) | 58 | 73 | 114 | 171 | 320 | 397 | 394 | 377 | 267 | 217 | 97 | 92 | 2,577 |
| *Temperature.* | | | | | | | | | | | | | |
| Mean maximum °F. | 76·6 | 77·4 | 75·4 | 72·1 | 67·4 | 63·2 | 61·9 | 63·4 | 66·1 | 68·5 | 72·1 | 74·8 | 69·9 |
| Mean minimum °F. (34 years) | 59·5 | 60·4 | 58·1 | 54·2 | 50·0 | 47·0 | 45·2 | 45·9 | 47·6 | 50·2 | 54·1 | 57·2 | 52·5 |
| Relative humidity (per cent.) ... | 61 | 63 | 65 | 69 | 75 | 79 | 77 | 74 | 69 | 64 | 62 | 61 | 68 |
| Meyer ratio (P : s.d.) | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 149 |
| Scaddan. | | | | | | | | | | | | | |
| Rainfall (points) (16 years records to 1933) | 47 | 47 | 126 | 151 | 224 | 221 | 157 | 198 | 143 | 151 | 92 | 95 | 1,652 |

After complete removal of the native scrubs and with proper fertilisation and management, crops of fodders such as oats, Tangier pea (*Lathyrus tangitanus*), lupin (*Lupinus* spp.), subterranean clover (*Trifolium subterraneum*), drooping flowered clover (*T. cernuum*), perennial veldt grass (*Ehrharta calycina*) and rye grasses (*Lolium* spp.) have been produced on a small scale.

The water supplies are abundant and wells may be generally obtained with good water within but a few feet of the surface. This water could be used for summer irrigation as well as for stock purposes. Care must be taken in selecting sites for wells as brackish water is frequently found at a depth of 6 to 15 feet.

In any pasture establishment liberal fertilisation is necessary. The dominant fertiliser is superphosphate, without which crops cannot be sucessfully grown, and grasses respond vigorously to the further addition of nitrogenous manures.

In the establishment of pines (*Pinus* spp.) difficulties have been experienced owing to the competition of the native heath and to parasitism by Munji or Christmas tree. It has been observed that pines, too, respond markedly to fertilisation with superphosphate.

Fruit trees and vegetables are grown to a limited extent in the vicinity of a few homesteads on the plain, but little is known of the economic possibilities in this direction. The principal use of the plain country at present appears to be confined to a limited amount of grazing, sheep and cattle being the chief stock raised.

## THE EXAMINATION OF THE SOILS OF THE ESPERANCE PLAIN.

To obtain data concerning the nature of the soils of the Esperance Plain two virgin sites were selected adjacent to the main north road some 12 miles north of Esperance and on the property of the Esperance Pine Forests Ltd., and type

samples were taken according to the profile. One site (Site 1) represented the shallow sandy type exhibiting eleven inches of grey siliceous sand on about 15 inches of loose gravel and sand. Below 26 inches an horizon of yellowish red and grey clay with soft gravel was encountered. The other site (Site 2) represented the deep, sandy type. Twelve inches of grey siliceous sand rested on 24 inches of yellow sand. The horizon of yellowish red and grey clay with soft gravel was encountered at 36 inches below the surface, the loose gravelly layer being absent.

The details of the profiles, as observed in the field, are given in Table 2.

TABLE 2.

FIELD NOTES CONCERNING THE PROFILES AT SITE 1 AND SITE 2 ON THE ESPERANCE PLAIN ABOUT 12 MILES NORTH OF ESPERANCE.

| Site. | Serial Number. | Depth. inches. | Soil. |
|---|---|---|---|
| 1 | 455 | 0—11 | Grey, fine sand. |
| | 456 | 13—26 | Loose pisolitic lateritic gravel with grey sand. |
| | 457 | 26—42 | Yellowish red and grey sandy clay loam with soft ferruginous gravel. |
| 2 | 458 | 0—12 | Grey fine sand. |
| | 459 | 12—24 | Yellow fine sand. |
| | 460 | 24—36 | Yellow fine sand. |
| | 461 | 38—45 | Yellowish red and grey sandy clay loam with soft ferruginous gravel. |

## THE MECHANICAL ANALYSIS.

The soils were examined in the Government Chemical Laboratory for mechanical analysis using the standard pipette method as described by Piper and Poole (1929).

The results are given in Table 3.

TABLE 3.

MECHANICAL ANALYSIS OF SOIL SAMPLES FROM THE ESPERANCE PLAIN.

Showing composition of fine soil and the percentage of stones in the samples as obtained in the field.

| Site. | Serial No. | Depth. | Coarse sand. 0·2 to 2·0 mms. | Fine sand. 0·02 to 0·2 mms. | Silt. 0·002 to 0·02 | Clay. Below 0·002 mms. | Moisture. | Loss on acid treatment | Loss on ignition. | Stones* (above 2 mms.) removed by sieving. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | inches. | % | % | % | % | % | % | % | % |
| 1 | 455 | 0—11 | 20·3 | 71·3 | 1·3 | 5·6 | 0·3 | 0·2 | 1·9 | 0 |
| | 456 | 13—26 | 27·1 | 56·2 | 1·7 | 12·5 | 0·7 | 0·7 | 4·0 | 83 |
| | 457 | 26—42 | 15·9 | 40·4 | 7·6 | 30·8 | 1·6 | 0·5 | 11·0 | 64 |
| 2 | 458 | 0—12 | 26·6 | 68·5 | 0·8 | 1·8 | 0·1 | 0·3 | 1·1 | 0 |
| | 459 | 12—24 | 28·4 | 65·6 | 1·2 | 4·4 | 0·2 | 0·3 | 1·1 | 0 |
| | 460 | 24—36 | 21·5 | 72·4 | 0·9 | 5·1 | 0·1 | 0·3 | 1·0 | 0 |
| | 461 | 38—45 | 21·5 | 47·7 | 6·2 | 23·5 | 1·3 | 0·7 | 6·3 | 64 |

* Percentage in the original soil. In each case the stones were almost entirely laterite.

## THE CHEMICAL ANALYSIS.

Part of the chemical work was performed in the laboratory of Messrs. Cuming Smith and Mount Lyell Farmers' Fertilisers' Ltd., Fremantle, and part in the Government Chemical Laboratory.

a. The analyses made in the laboratory of Messrs. Cuming Smith and Mount Lyell Farmers' Fertilisers' Ltd., consisted of the determination of total nitrogen and constituents soluble in 1.115 sp. gr. hydrochloric acid.

The results are tabulated in Table 4.

TABLE 4.

TOTAL NITROGEN CONTENT OF AND MATERIALS EXTRACTED BY 1·115 SP. GR. HYDROCHLORIC ACID TREATMENT OF SOIL SAMPLES FROM THE ESPERANCE PLAIN.

(Analysis by Cuming, Smith–Mt. Lyell Farmers' Fertilisers, Ltd.

| Site. | Serial No. | Depth. | Moisture. | Total Nitrogen. | Loss on Ignition. | Acid Insoluble residue. | Total Phosphoric Oxide $P_2O_5$ | Iron and Aluminium Oxides $Fe_2O_3$ and $Al_2O_3$ | Sulphuric Anhydride $SO_3$ | Lime CaO | Magnesia MgO | Soda $Na_2O$ | Potash $K_2O_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | inches. | % | % | % | % | % | % | % | % | % | % | % |
| 1 | 455 | 0—11 | 0·3 | 0·039 | 1·740 | 96·02 | 0·015 | 2·10 | 0·072 | 0·105 | 0·056 | 0·288 | 0·016 |
| | 456 | 13—26 | 0·7 | 0·028 | 3·915 | 89·12 | 0·018 | 6·99 | 0·087 | 0·131 | 0·040 | 0·072 | 0·004 |
| | 457 | 26—42 | 1·4 | 0·023 | 10·745 | 64·97 | 0·025 | 24·33 | 0·209 | 0·132 | 0·063 | 0·153 | 0·097 |
| 2 | 458 | 0—12 | 0·2 | 0·020 | 1·117 | 98·06 | 0·025 | 0·66 | 0·153 | 0·180 | 0·064 | 0·062 | 0·002 |
| | 459 | 12—24 | 0·1 | 0·013 | 1·071 | 97·10 | 0·023 | 1·65 | 0·091 | 0·105 | 0·031 | 0·057 | 0·002 |
| | 460 | 24—36 | 0·1 | 0·005 | 0·932 | 97·24 | 0·013 | 1·71 | 0·074 | 0·125 | 0·049 | 0·083 | 0·003 |
| | 461 | 38—45 | 1·2 | 0·005 | 6·314 | 78·48 | 0·010 | 15·72 | 0·148 | 0·106 | 0·099 | 0·289 | 0·087 |

b. The analyses made in the Government Chemical Laboratory included the examination of the fine soil fraction for water soluble salts, reaction, carbonate, exchangeable bases, saturation capacity for bases and the silica: sesquioxide ratio of the clay fraction. The results are detailed in Tables 5 and 6.

TABLE 5.

THE COMPOSITION OF SOIL SAMPLES FROM THE ESPERANCE PLAIN.

(Dry Soil Basis.)

| Site. | Serial No. | Depth. | pH (1). | Total Water Soluble Salts ppm (2). | Sodium Chloride from Chloride ppm. | Water Soluble Calcium ppm. | Water Soluble Magnesium ppm. | Carbonate as per cent. $CaCO_3$ |
|---|---|---|---|---|---|---|---|---|
| | | inches. | | | | | | |
| 1 | 455 | 0—11 | 6·48 | 170 | 66 | 2 | Trace | 0·027 |
| | 456 | 13—26 | 6·32 | 310 | 132 | 2 | do. | 0·064 |
| | 457 | 26—42 | 6·70 | 230 | 107 | 4 | 9 | 0·069 |
| 2 | 458 | 0—12 | 6·20 | 130 | 41 | 7 | 10 | 0·014 |
| | 459 | 12—24 | 5·74 | 210 | 33 | 11 | Trace | 0·023 |
| | 460 | 24—36 | 6·26 | 110 | 41 | 2 | Fair trace | 0·023 |
| | 461 | 38—45 | 6·29 | 230 | 74 | 2 | Trace | 0·041 |

(1) Quinhydrone, using 1 : 1 water suspension. (2) Using 1 : 5 water extract.

TABLE 6.

INFORMATION REGARDING THE PROPERTIES RELATED TO THE CLAY FRACTION OF THE SOILS.

| Serial No. | Depth. | Milli-equivalents per 100 grms. of soil. | | | | Total. | Percentage of total bases. | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | Mg | K | Na | | Ca | Mg | K | Na |
| | inches. | | | | | | | | | |
| 457 | 26—42 | 1·41 | 2·82 | 0·65 | 0·43 | 5·31 | 27 | 53 | 12 | 8 |
| 461 | 38—45 | 1·23 | 2·49 | 0·87 | 0·37 | 4·96 | 25 | 50 | 18 | 7 |

SATURATION CAPACITY.†

| Serial No. ... ... ... | 455 | 456 | 457 | 458 | 459 | 460 | 461 |
|---|---|---|---|---|---|---|---|
| Saturated capacity milli-equivalents per 100 gm. soil ... | 2·00 | 3·20 | 5·0 | 0·85 | 0·65 | 0·90 | 4·50 |

† Original soil pretreated with barium hydroxide prior to determining absorbed ammonium.

ANALYSIS OF CLAY FRACTION OF SERIAL No. 457.

| Per cent of Clay Fraction. | | | Molecular Ratios. | |
|---|---|---|---|---|
| By fusion: | | | | |
| $Fe_2O_3$ | $Al_2O_3$ | $SiO_2$ | $\frac{SiO_2}{Fe_2O_3 + Al_2O_3}$ | $\frac{SiO_2}{Al_2O_3}$ |
| 4·49 | 39·31 | 35·20 | 1·42 | 1·52 |
| Soluble in 5 per cent. NaOH: | | | | |
| $Al_2O_3$ | $SiO_2$ | | $\frac{SiO_2}{Al_2O_3}$ | |
| 23·04 | 12·64 | | 0·93 | |

## DISCUSSION OF RESULTS.

The most striking feature of the soils of the Esperance Plain as represented by these samples is the low content of certain plant foods. According to accepted European and American standards a normal soil should contain the following amounts of plant nutrients soluble in concentrated hydrochloric acid:—

| | | |
|---|---|---|
| Nitrogen, N ... ... | 0·10—0·15 | per cent. |
| Lime, CaO ... ... | 0·15—0·25 | „ |
| Potash, $K_2O$ ... ... | 0·15—0·25 | „ |
| Phosphoric oxide, $P_2O_5$ | 0·10—0·15 | „ |

Thus, total nitrogen, phosphoric oxide and potash are all extremely low in the soil samples analysed, and any system of agriculture adopted will need to make provision for the supply of these elements for crop growth. On the other hand the soil, although low in lime as calcium carbonate, is *relatively* well supplied with calcium, both total and water soluble.

The results of the examination of factors associated with the clay fraction provide further evidence of the low state of fertility of these soils. The clay is rich in alumina and iron oxide which is an indication of considerable leaching and this type of clay has a low capacity for holding bases such as lime, potash, etc. The total base absorbing capacity of the subsoils, as determined by the barium hydroxide method, is only about 5 milli-equivalents per 100 gm. of soil which is equivalent to less than 20 milli-equivalents per 100 grams of clay. Normal soils show figures ranging from three to five times this magnitude. The composition of the replaceable base fraction shows an unusually high proportion of magnesia and the soils would be classed as magnesium-calcium soils. Sodium is low and there is no structural evidence of solonisation. Replaceable potash is relatively rich and indicates no immediate lack of available potash.

The clay fraction of sample 457 was analysed for content of alumina, iron oxide and silica and the results indicate an accumulation of sesquioxides ($Al_2O_3$ and $Fe_2O_3$) which, in these circumstances suggests laterisation. It is also apparent that free alumina occurs in the clay fraction.

The slightly acid reaction of the soils as shown by pH determinations is most favourable for the growth of most crops. Water soluble salts are very low and there is no possibility of an alkali problem arising. True, the swamps often contain brackish and salt water, but it appears that the salt is confined to these depressions.

Mechanical analysis and microscopic examination of the samples show that the surface layer consists almost entirely of coarse and fine sand and the sand grains are particles of quartz showing very definite desert abrasion, the grains

practically all showing the typical rounded angles. The contour of the country and the variations in depth of the sand layer suggests that this rounding has been accomplished as a result of ages of movement back and forth due to wind action on the plain.

Prescott (1931, p. 48) has suggested that this gravel or laterite occurring beneath the surface sand is *fossil* in character, that is, it is a relic of a past geological age when the climate was much wetter than at present. As opposed to this is the opinion expressed by Simpson (1912) who considers that the laterite is forming at the present time and represents a "true efflorescence, that is a deposition on the surface of the ground of substances dissolved by underground water brought to the surface by capillarity, and there deposited as solid matter owing to aeration and evaporation of the water."

Field observations lead one of the authors (L.J.H.T.) to support strongly the view published by Prescott. It is considered that the facts that, first, the formation of brown earth soils where gneissic granite outcrops occur, and second, the occurrence of gravelly soils contiguous with but distinct from, the calcareous solonised soils of the "mallee" zone, are strong evidence that the ferruginous gravels are not products of the present age but represent the fossil remains of a soil of past ages. Only the refractory constituents, silica and the sesquioxides of iron and aluminium, remain as the principal parent materials on which the present soil is forming. On this account the soil of the plain to-day is quite different from the types regarded as normal under present climatic conditions: that is, from the brown earths and "mallee" soils. Both hypotheses offer an explanation of the very low content of plant nutrients such as phosphoric oxide and potash, etc. It is possible that the more generous quantities of lime and soda have been washed down as cyclic salts by the rain, which is relatively rich in sea salts along the Southern coast.

## AGRICULTURE.

As yet the Esperance Plain is practically undeveloped for modern agriculture. In the first place, the soils are inherently of low fertility, and no natural pastures exist. In the second place, there has been little urge to develop the tract as markets have been well supplied from other sources.

The limited experience already gained on the plain proves that development is possible, and that, with a liberal manurial programme coupled with sound management of introduced pasture plants adapted to the conditions, stock raising will be successful. There are indications, too, that pine plantations may be successful if scrub competition is eliminated and manuring of the trees practised.

It seems unlikely that further development of the plains can reasonably be expected until the economic situation with respect to agricultural products has changed. When there is a demand for the produce which this area will be able to supply, private or other enterprise will, no doubt, respond and take advantage of any opportunities offered.

## SUMMARY.

The soil and climatic conditions of the Esperance Plain are discussed. The Esperance Plain may be regarded as a rolling heath formation sloping southwards to the coast. The climate is of the Mediterranean type, and the average annual rainfall ranges from 25 inches at Esperance to about 17 inches at Scaddan, the northern limits of the plain. The typical soil profile is grey siliceous sand with a yellow, red and grey gravelly sandy clay loam subsoil. Analysis shows the clay to have a silica sesquioxide ratio of about 1.5 and indicates the presence of free alumina. The total replaceable bases are low and the replaceable base capacity very low. The chief base is magnesium and the clays would be classified in the magnesium-calcium group.

The soils are poor in certain plant nutrients and will need liberal fertilisation for the production of crops suited to the conditions of the plain.

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1931—"The Soils of Australia in Relation to Vegetation and Climate."—C.S.I.R. (Aust.) Bull. No. 52.

**Simpson, E. S.:**
1912—"Laterite in Western Australia."—Geol. Mag., Decade V., 9: 399-406.

### ACKNOWLEDGMENTS.

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## AGRICULTURAL PROBLEMS

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

| | |
|---|---|
| Albany ... ... ... ... | A. C. Vaughan. |
| Bridgetown ... ... ... ... | A. Flintoff. |
| Bunbury ... ... ... ... | M. Cullity. |
| Denmark ... ... ... ... | V. L. Cardon. |
| Geraldton ... ... ... ... | G. L. Throssell (Government Buildings). |
| Gosnells ... ... ... ... | R. C. Owen. |
| Harvey ... ... ... ... | D. L. Breen (Fruit); C. Giles (Dairying). |
| Katanning ... ... ... ... | A. S. Wild |
| Kalamunda-Roleystone ... ... | W. H. Read, c/o. Department of Agriculture, Perth. |
| Manjimup ... ... ... ... | K. W. Simes. |
| Metropolitan, Gingin, Chittering ... | S. E. Bennett, c/o. Department of Agriculture, Perth. |
| Metropolitan to Spearwood ... | R. L. Cailes, c/o. Department of Agriculture, Perth. |
| Mundaring ... ... ... ... | V. Cahill. |
| Narrogin ... ... ... ... | H. R. Powell. |
| Northam ... ... ... ... | F. L. Shier. |
| Northcliffe ... ... ... ... | H. S. Rogers. |
| Vasse ... ... ... ... | J. M. Nelson. |

# STALLION REGISTER, 1936-37.

Registrations up to 2nd December, 1936.

* D. draught ; T. thoroughbred ; Tr. trotter ; P. pony : Ar. arab
Age in years : A. aged.

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| Admiral Fyvie ... ... ... | A.D. | C. E. Potts, Pingelly |
| Agrion ... ... ... ... | A.T. | N. Ramsay & Sons, Capel |
| Ahitana Bold ... ... ... | A.D. | R. Snow, Wickepin |
| Aldersyde Hero ... ... ... | A.D. | J. B. Stacey, Southern Cross |
| Allandale Duplicate ... ... | 6 D. | G. Hatwell, Dowerin. |
| Alvie Lad ... ... ... | 4 D. | E. W. Whittington, Brookton |
| Anama Cashier ... ... ... | 4 D. | S. Hunter, Yandanooka |
| Anama Renown ... ... | A.D. | A. Sanders, Dowerin |
| Anchor ... ... ... ... | A.Ar. | A. A. Toll, Highbury |
| Annandale Baron ... ... | 5 D. | J. Carruthers, Lake Grace |
| Armada ... ... ... ... | A.D. | Mrs. O. B. McIntyre, Lomos |
| Auchen Pride ... ... ... | 6 D. | J. Fitton, Moulyinning |
| Avinak Major ... ... ... | 4 D. | Thorn & Champness, Kojonup |
| Avon Lad ... ... ... ... | A.D. | J. H. Bullock, Kulin |
| Barney ... ... ... ... | A.D. | A. Low & Son, Kellerberrin |
| Baron Banchory ... ... ... | 7 D. | P. Strange, Yarding |
| Baron Brayton ... ... ... | A.D. | J. Carr, Beverley |
| Baron Breastknott ... ... | A.D. | A. R. Yates, Kulikup |
| Baron Broadway ... ... | D. | J. Halligan, New Norcia |
| Baron Buchlyvie Stamp ... | 7 D. | J. Wood, Mullewa |
| Baron Dale ... ... ... | A.D. | A. W. Wilkins, Dukin |
| Baron's Fancy ... ... ... | 7 D. | F. S. Morgan, Quindanning |
| Baron Hillgrove ... ... ... | 7 D. | G. E. & N. S. Schilling, Bungulluping |
| Baron Hillside ... ... ... | 7 D. | R. Gault, Greenhills |
| Baron John ... ... ... | A.D. | G. L. Tippett, Erikin |
| Baron Lee ... ... ... ... | A.D. | M. A. Wickham, Yarloop |
| Baron's Pride ... ... ... | 7 D. | W. J. Maynard, Red Lake |
| Baron's Sovereign ... ... | A.D. | S. G. Gill, Kulyalling |
| Baron Stamp ... ... ... | 3 D. | Southall & Young, Wickepin |
| Baron's Stamp ... ... ... | A.D. | Mrs. F. M. McKee, Lake Camm |
| Baron Victor ... ... ... | 6 D. | E. G. Marsh, Kojonup |
| Baron Walder ... ... ... | 7 D. | C. J. Neill, Boyanup |
| Baron Ward ... ... ... | A.D. | J. N. Lord, Narembeen |
| Beau Valley ... ... ... | 4 D. | G. J. Bostock, Pingelly |
| Beechside Middy ... ... ... | A.D. | L. B. Bolton, Namban |
| Bill Adey ... ... ... ... | 6 D. | H. R. Renk, Damboring |
| Bingley Lad ... ... ... | 4 D. | A. J. Young, Kondinin |
| Black Douglas ... ... ... | 3 D. | B. J. K. Doornbusch, Harvey |
| Black Oak ... ... ... | A.D. | F. E. Brockman, Dudinalup |
| Black Pottadale ... ... ... | 5 D. | S. D. Broadbent, Wongan Hills |
| Black Prince ... ... ... | 6 D. | Franklin & Sons, Wyola |
| Bloomfield Sensation ... ... | 7 D. | L. R. Blight, Mukinbudin |
| Blue Ribbon Hero ... ... | 7 D. | L. S. Bell, Katanning |
| Bob ... ... ... ... | 7 D. | Trotter Bros., Kulin |
| Bold Enterprise ... ... ... | 4 D. | W. R. Falconer, Trayning |
| Bold Everest ... ... ... | 7 D. | R. Carroll & Sons, York |
| Bold Major ... ... ... | 7 D. | C. W. Heal, Quairading |
| Bonny ... ... ... ... | A.D. | C. A. Richter, Wickepin |
| Boxer ... ... ... ... | 6 D. | J. Lloyd, Lake Biddy |
| Boxer ... ... ... ... | 8 D. | V. H. Francis Lane, Three Springs |
| Brackenhurst Monarch ... ... | 4 D. | Taylor & Sons, Dangin |
| Brilliant Stamp ... ... ... | 6 D | R. G. Willcocks, Pingrup. |
| Brilliant Starlight ... ... | 8 T. | C. Mitchell, Dinninup |
| Brilliant Town ... ... ... | 6 T. | Yaragadee-Nalbarra Past. Co., Mingenew |

STALLION REGISTER, 1936-37—*continued.*

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| Broadview Winalot | 8 D. | R. Carroll & Sons, York |
| Brown Brilliant | A.D. | W. W. Clothier, Walgoolan |
| Broxstead Lawyer | 4 D. | J. McCallum Smith, Perth |
| Bruce | A.D. | T. Johnson, Yandanooka |
| Bruce | 8 D. | T. Beswick, Yealering |
| Bulagin Major | 8 D. | J. E. Peters, Wyalkatchem |
| Bullaro Bandsman | 6 D. | R. H. Wahlsten, Walgoolan |
| Burnside Viceroy | 4 D. | R. Kirkham, Yarloop |
| Calcarra Prince | 3 D. | A. Haynes, Calingiri |
| Caledonia | 7 D. | M. Farrell, Perenjori |
| Captain | 7 D. | W. Teakle, Isseka |
| Captain Kid | A.D. | R. P. Gaston, Koolanooka |
| Carngham Baron Jim | A.D. | McLarty Bros., Pinjarra |
| Carngham Bold | A.D. | M. S. Aunger, Carnamah |
| Castle Ray | 7 D. | C. L. Perry, Darkan |
| Champ | 5 D. | M. S. Fisher, Kweda |
| Charlie | A.D. | A. J. Neal, Yelverton |
| Chief | 4 D. | C. F. Mathews, Mumballup |
| Christmas | 3 D. | B. W. G. Hopwood, Bencubbin |
| Claphamdale | 8 D. | F. W. Wright & Co., Dalwallinu |
| Clifton Flashdale | 8 D. | J. Harrod, Kununoppin |
| Clyde | 7 D. | S. L. E. Lange, Popanyinning |
| Con of Buchlyvie | A.D. | M. J. Bennett, Lake Grace |
| Coorara Flash Ronald | 5 D. | P. Falconer, Trayning |
| Cora Lyn | 7 D. | T. W. Ward, Ballaying |
| Cracksman | 5 D. | N. Lemmon, Ongerup. |
| Craigie Emblem | 7 D. | L. H. Lawrence, Northam |
| Craig Lion | A.D. | A. H. Rathjen, Muntadgin |
| Craig Noble | 7 D. | A. T. Zwar, Merredin |
| Craigie Buchanan | 3 D. | W. Pollard, East Wagin |
| Craigie Prince | 4 D. | G. S. Wilson, Wickepin |
| Culloden | 6 D. | J. Watkins, Wagin |
| Culrain | 6 D. | E. Williamson, Kondinin |
| Dalmeny Dene | 2 D. | H. N. Higham, Williams |
| Dalmeny Footstep | 5 D. | A. Della, Wannamal |
| Dalmeny Glencoe | 2 D. | Estate of J. W. Parker, York |
| Dalmeny Hillside | 6 D. | L. M. Oliver, Jennapullen |
| Dalmeny Renown | A.D. | W. Jones, Walkaway |
| Decorum | A. Tr. | W. R. B. Donnan, Tammin |
| Dondakin Blaze | 4 D. | A. M. Martin, Corrigin |
| Don McDonald | A.D. | H. D. Broad, Round Hill |
| Doon Auchen Brae | 6 D. | A. F. Bennett, Dumbleyung |
| Doon Auchen Gift | 4 D. | Mrs. E. Bushalla, Narrogin |
| Doon Auchencraig | 6 D. | A. W. Stone, South Quairading |
| Doon Loch | 5 D. | D. S. Walker, Balingup |
| Dora's Dunure | A.D. | Edgar Bros., Glentromie |
| Douglas Cobham | A.D. | W. Fraser, Dowerin |
| Drysdale Lothian Craig | 2 D. | Estate of W. W. Mitchell (W.A. Trustees, Perth) |
| Duke | 5 D. | J. McKeever, Moora |
| Duke | 2 D. | A. J. Monger, York |
| Dunbar | D. | N. G. Maddock, Lake Brown |
| Dunlop | 5 D. | G. Goodall, Kojonup |
| Dunure's Pride | 4 D. | J. B. Spurr, Kalgarin Hill |
| Earlstone | A.D. | R. T. Jenkins, Wagerup |
| Easingwold | A.T. | W. Marks, Fremantle |
| Eastern Hero | 6 D | R. P. Wardle, Moora |
| Easy Tigne | 6 Tr. | W. H. Wright, Mandiga |

STALLION REGISTER, 1936–37—*continued.*

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| Edenhope Beauty's Masterstroke | 4 D. | J. H. Ferrier, Wickepin |
| Emblem's Ambition | 3 D. | H. Richards, Dowerin |
| Emblem Yet | 3 D. | W. H. Gale, Jennapullen |
| Enfield Monarch | 6 D. | C. Smith & Son, Erikin |
| Erindale Glengyle | 6 D. | Epsin & Sons, Manjimup |
| Eudamatch | A.T. | F. T. Carter, Tammin |
| Eureka Print | 5 D. | D. Negri, Bruce Rock |
| Eureka Stamp | 4 D. | J. Fitton, Moulyinning |
| Fairfield Royal Banker | 8 D. | A. McD. Sargent, Katanning |
| Fair Valley | 6 D. | G. E. Carr, Beverley |
| First Admiral | 6 D. | J. Warren, Perth |
| Flaming Star | 8 T. | R. P. Bryant, Quairading |
| Flash Mac | A.D. | R. Carroll & Son, York |
| Flash Pettadale | A.D. | J. Peden, Wagin |
| Flash Willie | 5 D. | H. P. Jolly, Nungarin |
| Foxlow Stanley | 7 D. | W. N. Hedges, Perth |
| Fyvielea Pearl | 5 D. | Senator P. J. Lynch, Three Springs |
| Gay Baron | 6 D. | E. Rose, Bunbury |
| Geordie | A.D. | R. J. McCarthy, Esperance |
| Gigolo | 7 T. | H. E. Vail, Herne Hill |
| Glencoe Victor | 5 D. | C. W. Bateman, East Beverley |
| Glenrowan | 6 D. | A. E. Ray, Burracoppin |
| Glenvarloch | 6 D. | J. H. Walker, Kukerin |
| Golden Wheat | A.T. | A. E. Cockram, Belmont |
| Great Scott | 5 D. | W. Linto, York |
| Greenlea Crystal | 7 D. | C. J. Roberts, Dandaragan |
| Gumpark Favourite | A.D. | H. G. Bolt, Katanning |
| Hazeldene Footprint | 3 D. | A. McCallum, Muntadgin |
| Homebush Chester | 8 D | R. W. Moodie, Westonia |
| Homebush Dandy | 8 D. | T. Robinson, Pemberton |
| Homebush McDonald | 4 D | W. J. Kingston, Denmark |
| Homebush Pride | 7 D. | F. L. Martens, Pingrup |
| Homebush Sampson | 7 D. | A. G. White, Yandanooka |
| Homewood Tartan | 3 D. | E. A. Nelson, Vasse |
| Howqua Dale | 8 D. | J. O'Toole, Gnowangerup |
| Inglestone | 4 D. | H. A. Nalder & Sons, Wagin |
| Inverell Footprint | 4 D. | Thomson Bros., Greenbushes. |
| Isle of Avon | 3 T. | A. H. Mead, East Rockingham |
| Jenvale Style | 3 D. | J. McDonald, Gnowangerup |
| Jimmy Douglas | 5 D. | H. S. Riley, Trayning |
| Johnny Walker | 4 D. | T. Farmer, Farmer's Crossing |
| Joker | 3 D. | F. K. Minchin, West Swan |
| Kaburnie Mac | 4 D. | J. C. Moir, Gutha |
| Kathleen Vale Style | 6 D. | W. J. Pethick, Winchester |
| Kayanaba Don | 5 D. | H. P. Halligan, New Norcia |
| Kayanaba Pilot | 5 D. | T. W. Ward, Ballaying |
| Kierallan | 3 D. | Maughan Bros., Walgoolan |
| Kildare | 5 P. | Mrs. V. Cobbin, Subiaco. |
| Killarney Auchenflower | 4 D. | C. Smith & Sons, Erikin |

STALLION REGISTER, 1936–37—*continued.*

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| King | 7 D. | J. Grant, Perenjori |
| King Cole | 6 D. | R. W. Mortimore, Wadderin Hill |
| King Ronald | 4 D. | G. A. Carslake, Gutha |
| Koojan Flashlight | 8 D. | W. Padbury, Three Springs |
| Koojan Prince Norval | A.D. | A. E. Grant, Geraldton |
| Koorikin Pride | 5 D. | W. J. B. Hawkins, Kondinin |
| Laddie | 5 D. | H. S. Beard, Jennapullen |
| Laddie | A.D. | F. Bussell Vines, Busselton |
| La Fayette | A. Tr. | D. Stevenson, Moulyinning |
| Lakeside Bold Bute | A.D. | Shadbolt Bros., Mukinbudin |
| Lakeside Pilot Bute | 5 D. | J. Knapp, Ballidu |
| Langi Masterpiece | 4 D. | C. C. Smith, Three Springs |
| Leurgon Holton Honour | 5 D. | H. Wornum & Sons, Tenterden |
| Lochiel | 5 D. | J. C. Hogan, Brookton |
| Longernong Dignity | 8 D. | E. Williams, Northampton |
| Lord Banker | 8 D. | A. W. Hewton, Wyalkatchem |
| Lord Charmer | A.D. | N. F. West, Wagin |
| Lord Lomon | A.D. | R. T. Wheatley, Bridgetown |
| Lord Patchem | A. Tr. | G. G. Sinclair, Toodyay |
| Lord Roseberry | A.D. | W. Morgan, Wagin |
| Lothian's Gem | 5 D. | S. & Y. Dowsett, Dwarda |
| Lothian Prince | 8 D. | G. S. Dayman, Emu Hill |
| Loudon Castle | 3 D. | P. Strange, Yarding |
| Loudon Duke | 7 D. | A. Eldred, Salmon Gums |
| Loudon Stamp II. | 8 D. | Growden Bros., Nangeenan |
| Lucky | 6 D. | W. J. Drage, Mt. Barker |
| Lyndhurst | A.D. | E. A. Ebsary, Wickepin |
| Mac | 8 D. | H. W. Fitt, Narrogin |
| Major | 2 D. | H. A. Metcalf, Dowerin |
| Major Douglas | 6 D. | J. Piggin, Trayning |
| Major Hillside | 8 D. | R. S. Parnell, Gnowangerup |
| Major Hurst | 7 D. | F. J. Erhardt, Dowerin |
| Mangowine Footstep | 4 D. | J. Jolly, Nungarin |
| Marco Secundus | 7 T. | C. R. Mitchell, Wagin |
| Marshall Valley | 4 D. | A. L. Neville, Yealering |
| Master Celtic | A. Tr. | H. Patroni, Donnybrook |
| Master Pilot | 3 D. | G. Hatwell, Dowerin |
| McKie Prince | 7 D. | W. H. Wright, Mandiga |
| Meudic | A.T. | Benedictine Community, New Norcia |
| Mick | 4 D. | T. P. Duggan, Yericoin |
| Mick | A.D. | F. G. Parnell, Tinkurrin |
| Mile Pool Hero | 3 D. | A. F. Pipe, Damboring |
| Model Farm Pride | A.D. | J. A. W. Nicol, Mt. Barker |
| Mokine Stamp | 4 D. | V. L. Blight, Highbury |
| Mona Park Baron | A.D. | Wiese Bros., Highbury |
| Monsoon | A. Tr. | L. Burton, Osborne Park |
| Moorland's Captain | A.D. | A. V. Moore, Doodlakine |
| Mussolini | 8 D. | W. G. Foote, Albany |
| Nariel Banker | 7 D. | L. J. Stacey, Quairading |
| Narkedah | A.T. | Darlot Bros., Ltd., Mingenew |
| Native Prince | 6 D. | C. Scott, Bullfinch |
| Neumylda | A.T. | Penn Bros., Northampton |
| Newbold Belmont | 5 D. | E. Ludeman, Wattening |
| Newbold Emperor | 6 D. | R. Carroll & Sons, York |
| Newbold Pendant | 5 D. | Prowse Bros., Doodlakine |

STALLION REGISTER, 1936 37—*continued.*

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| Newfield's Ambition ... ... | 8 D. | C. G. & A. E. Nicholas, Gnowangerup |
| Newfield's Sensation ... ... | 6 D. | E. P. Young, Kondinin |
| Noble ... ... ... ... | 3 D. | J. Lussich, Miling |
| Nonsuch Style ... ... ... | A.D. | M. H. Erhardt, Dowerin |
| Nover ... ... ... ... | 7 D. | C. D. McDonald, Redmond |
| Oakdale Balnakill ... ... | 5 D. | E. D. P. Hayes, Toodyay |
| Oaklyn Refiner ... ... ... | 6 D. | V. G. Rennie, Gingin |
| Olympian ... ... ... ... | 7 T. | F. A. Farquhar, Gingin |
| Penryn Leader ... ... ... | 6 D. | S. L. Folland, Waddy Forest |
| Peter Baron ... ... ... | 7 D. | J. J. Weinert, Narrogin |
| Peter Pan ... ... ... ... | 4 D. | W. T. Poole, Kondinin |
| Peter of Triagen ... ... ... | 8 D. | W. Potthoff, Kondinin |
| Peter Stretta ... ... ... | A. Tr. | Dr. A. Juett, Perth |
| Peter Voyager ... ... ... | A. Tr. | W. Pratt, Muntadgin |
| Pilot ... ... ... ... | 7 D. | F. J. Ridge, Morawa |
| Pine Vale Peter ... ... ... | 4 D. | Mrs. R. G. Dayman, Kwelkan |
| Pride ... ... ... ... | A.D. | W. Mullan, Harrismith |
| Premier Willie ... ... ... | 4 D. | Wiese Bros., Highbury |
| Prince ... ... ... ... | 4 D. | A. E. Green, Bencubbin |
| Prince ... ... ... ... | 4 D. | A. T. Sloan, East Rockingham |
| Prince ... ... ... ... | 4 D. | H. Mellersch, East Yuna |
| Prince ... ... ... ... | 7 D. | A. Piesse, Wagin |
| Prince Aubry ... ... ... | 6 D. | C. H. Georgy, Kalannie |
| Prince Belmont ... ... ... | 7 Tr. | A. J. Reither, Pingelly |
| Prince Bold ... ... ... | 7 D. | H. W. England, Bowgada |
| Prince Charlie ... ... ... | 7 D. | C. Whittington, Brookton |
| Prince Kerrston ... ... ... | A.D. | Black Bros., Harvey |
| Prince Lomon ... ... ... | 6 D. | G. Fontanini, Manjimup |
| Prince Paladin ... ... ... | 5 D. | S. King, Goomalling |
| Prince Pilot ... ... ... | 3 D. | D. Stevenson, Moulyinning |
| Prince Robert ... ... ... | 7 D. | L. Brissenden, Muntadgin |
| Prince Roland ... ... ... | 5 D. | H. McCormick, Gingin Brook |
| Prince Roy ... ... ... | A.D. | D. Hehir, Yandanooka |
| Proctor ... ... ... ... | A.T. | J. A. Barry, Redcliffe |
| Punch ... ... ... ... | 7 D. | G. M. L. Reynolds, Dindiloa |
| Robin ... ... ... ... | A.D. | H. Hamersley, Wagin |
| Rob Roy ... ... ... ... | 3 D. | J. Rogie, Pingelly |
| Rochindale Beaudonia ... ... | 3 D. | A. H. Reynolds, Meckering |
| Rochindale Flashdell ... ... | 3 D. | C. S. Jacobsen, Bunjil |
| Roslyn Boy ... ... ... | 4 D. | A. J. Flanagan, Bunbury |
| Roslyn Master ... ... ... | 7 D. | R. Carroll & Son, York |
| Roslyn Douglas Viceroy ... | A.D. | Beiker Bros., Wagin |
| Roslyn Radiant ... ... ... | 5 D. | Yaragadee-Nalbarra Pastoral Co., Mingenew |
| Rotanic ... ... ... ... | 4 T. | R. J. Hodgson, Minnivale |
| Rothsay Prince Craig ... ... | 5 D. | W. G. Argent, Kulin |
| Rowdy ... ... ... ... | 6 D. | C. Eyden, Highbury |
| Roy ... ... ... ... | 7 D. | G. H. Jones, Yandanooka |
| Royal Appotenic ... ... ... | 5 D. | G. M. Stafford, Karlgarin Hill |
| Royal Favourite ... ... ... | 4 D. | L. J. Hilder, Narrogin |
| Royal Noble ... ... ... | 4 D. | N. C. Badger, Pingrup |
| Royal Prince ... ... ... | 6 D. | W. A. T. Sargent, Carnamah |
| Royal Star ... ... ... | A.D. | G. Irving, Cranbrook |
| Sansofine ... ... ... | 4 T. | A. E. Cockram, Belmont |

STALLION REGISTER, 1936–37—*continued.*

| Name of Horse. | *Age and Class. | Name and Address of Owner. |
|---|---|---|
| Scheyvilleure Librarian ... ... | 8 D. | J. Harrod, Kununoppin |
| Scotch Willie II. ... ... ... | 6 D. | J. H. Price, Narembeen |
| Sea Crest ... ... ... ... | A.T. | L. W. Viveash, Northam |
| Silverdale ... ... ... ... | A.D. | C. D. Garston, Woodanilling |
| Silver Prince ... ... ... | D. | J. H. Barnes, Kellerberrin |
| Simpson's Earl ... ... ... | A.D. | W. C. Simpson, Round Hill |
| Sir Carleton ... ... ... | 4 D. | G. G. Pallant, Kellerberrin |
| Sir James ... ... ... ... | A.D. | E. Vanzetti, Marchagee |
| Sir Walter Raleigh ... ... | 7 D. | W. J. Bowers, Gingin |
| Some Scotch ... ... ... | A.D. | R. J. M. Fairclough, East Katanning |
| Spats ... ... ... ... | A. Tr. | Cowcher Bros., Williams |
| Star ... ... ... ... | 6 D. | D. Gunn & Son, Kellerberrin |
| Strathaird ... ... ... ... | D. | J. Davies, Dalwallinu |
| Sunflower ... ... ... | 6 D. | J. L. Ward, Nippering |
| Sunnylands Craig Fashion ... | 7 D. | J. M. Young, Gwambygine |
| Sunnyside Alick ... ... ... | A.D. | Page Bros., West Pingelly |
| Sunny Style ... ... ... | 4 D. | F. Packham, Tammin |
| Tandarra Baron ... ... ... | A.D. | G. Ferrier, Mingenew |
| Tandarra Earl ... ... ... | 4 D. | J. Tolley, Doodlakine |
| Target ... ... ... ... | 6 T. | H. A. Metcalf, Dowerin |
| Taunton Robin Adair ... ... | 6 D. | S. O. Argent, Lake Grace |
| Tiger ... ... ... ... | 7 D. | L. M. Baikie, Quairading |
| Tipperary ... ... ... ... | 7 D. | R. H. Fulwood, Cunderdin |
| Treat ... ... ... ... | A.T. | H. E. Vail, Herne Hill |
| Trooper ... ... ... ... | 8 D. | G. J. Butterworth, Katanning |
| Tynedale Duke ... ... ... | 5 D. | E. Armstrong, Lake Brown |
| Tynedale Flashlight ... ... | 4 D. | J. Lampard, Waddy Forest |
| Tynedale Kenwyn Again ... | 5 D. | R. A. Wise, Moojebing |
| Valerano ... ... ... ... | A.T. | Benedictine Community, New Norcia |
| Valetta Royal Hero ... ... | 5 D. | E. Raynor, Dalwallinu |
| Veradale Roderick ... ... | 5 D. | W. Waddell, Walgoolan |
| Victoria Shamrock ... ... | 8 D. | S. B. Rudduck, Coorow |
| Wallad ... ... ... ... | 7. Ar. | C. C. Readhead, Mingenew |
| War Dance II. ... ... ... | 7 D. | P. Briotti, Koorda |
| War General ... ... ... | 8 D. | C. A. Sweeting, Tammin |
| Wendourie Auchenflower... ... | 6 D. | P. J. Collins, Tambellup |
| Werndew Squire ... ... ... | 5 D. | H. W. Biglin, Kondinin |
| Werrap Minstrel ... ... ... | 4 D. | W. Caley, Corrigin |
| Werrap Pride ... ... ... | 5 D. | L. C. Cusbert, Bruce Rock |
| West Wimmera ... ... ... | 8 D. | W. G. Hallam, Red Lake |
| Widgiewa Boldy ... ... ... | 3 D. | F. Hobbs, Beverley |
| Wilfred ... ... ... ... | A. Tr. | W. P. Baker, Perth |
| Wilyara Roselock ... ... | 5 D. | T. H. Leake, Kellerberrin |
| Wireless ... ... ... ... | 3 D. | A. E. Stevens, Kellerberrin |
| Woolie ... ... ... ... | A.D. | J. Thomson, Donnybrook |
| Yadlock ... ... ... ... | 4 T. | D. C. Pearce, Kojonup |
| Yodelist ... ... ... ... | A.T. | H. H. Roberts, Capel |

# CARNIOLAN BEES.

H. Willoughby Lance, Government Apiculturist.

A contributor, writing in "The Bee World" about different races of bees, says:—"Recently it has been found that another race possesses all the good qualities of both black and yellow, besides showing other very desirable features. 'Grey Carniolans' are as quiet upon the combs and even gentler than Italians. They are as hardy and as good workers as any blacks can be, but combs built by greys are snow white and clean, and in their hives there is always very little profolis, so that combs are readily removable.

"Of still greater importance for the beginner as well as for the professional is the fact that, by proper management, they can easily be induced to rear brood both in and out of season, so the very smallest nucleus will rapidly build up to a powerful colony. Therefore, grey Carniolans are the only bees for the commercial migratory beekeeper wanting to obtain large honey crops in spring, summer and autumn."

One of Hochegger's movable house-apiaries on wheels, containing from 40 to 50 strong Carniolan colonies.

—"The Bee World."

All that this correspondent says is confirmed by our experience in Western Australia—the verdict of those that have given them a trial is that they are the race best suited to our State. One large firm of commercial beekeepers that has tried all the available races of bees commenced with Carniolas and for two or three years carefully compared them with the other races, with the result that 80 per cent. of their bees are now Carniolan, or have the Carniolan strain on either the Queen or the Drone's side.

Carni-Italian (Carni Queen and Italian Drone) or Italian-Carni (Italian Queen and Carniolan Drone) are found to be equal to Carniolan pure in most cases, except that they are not always so quiet to handle, but after the second or third generation they usually lose some of their most desirable characteristics. It is advisable, therefore, to introduce fresh pure stock at least every two years.

It is with the object of being able to supply pure stock that the Government have established a Carniolan Apiary at Rottnest Island. The Island is 12 miles from the mainland and as there are no other bees on the Island, there can be no doubt about the purity of the race being maintained. In order to keep up the stamina of the race which comes from the cold Alpine climates, the department imports fresh queens each year, direct from the leading breeder in Carniola. Queens are bred from the recently imported ones, and mated to drones from previous stock.

Briefly summarised, the advantages of the "Grey" Carniolans are:—

(1) They are longer lived than Italians or Blacks, and as a consequence there is less brood in the hives for the same strength of colony.

Rottnest Mating Apiary, 1936.

(2.) They produce more honey than the average Italian or Black, no doubt partly due to the fact that they require less brood to keep up the strength of the hives, and, therefore, consume less food in brood rearing. They also appear to have stronger wings than the other races, which would doubtless account for their longer life and better honey-storing capacity, as they can work in wet and windy weather. Carniolans are particularly suited to the South-West. The Karri blossoms all through the winter, and Carniolans will work it when Italians stay at home. This is most important for the apiarist of the extreme South-West, as Karri is the principal honey-producer and only blossoms once in four or five years. Sections produced by Carniolans in the Karri Districts have beautiful white comb, and fetch a good price in the shops.

(3.) They are very quiet to handle. During the honey season, one never need wear a veil, and very little smoke, if any, is required. Of course, when there is a dearth of honey or hives have been badly disturbed, the quietest colonies become somewhat pugnacious. At our Rottnest Mating Apiary it is most unusual to put on a veil, and frequently the whole apiary is gone through without using the smoker. Occasionally for some special reason, a few hives may start stinging; this, however, is

the exception rather than the rule. I have opened hives under urgent circumstances half an hour before sunset and have almost been driven away from Italian colonies, but have had no difficulty with Carniolans.

In past years there has been a prejudice against Carniolans, as they were reported to be great swarmers. This has not been borne out by recent experience in Australia. The prejudice was probably due to the fact that in the early days the importance of plenty of room in advance was not realised by beekeepers. It is generally recognised in these days that to obtain a good honey crop and to reduce swarming, the bees must have plenty of room in advance. The Carniolans, being rapid honey-gatherers, probably caught many beekeepers napping, with the result "swarming." Mr. W. S. Pender, writing in the "Australian Bee Keeper," said that he had been trying Carniolans for two seasons, and that he "gave these Carniolans every inducement to swarm, the hives being left over-full of honey, and had not had one swarm from them in his apiary of 30 colonies. The only two swarms he had were pure Italian."

Now I would not advise beekeepers to "give them every inducement to swarm," to test them as Mr. Pender did. I would say "give them plenty of room to store," so that you may obtain the full advantage of the honey crop.

In working with Carniolan Bees, apiarists should note that the Carniolan is usually somewhat later in commencing to breed rapidly than the Italians. They appear to wait until there is a prospect of a honey flow; but when they do start, they soon catch up to the Italians. Consequently many beekeepers have been caught napping. They have compared the brood in Carniolan colonies with Italians, and considered that they had plenty of room. A few weeks later they are surprised to find that the Carniolans are over-crowded. MORAL—Give Carniolans plenty of room in advance.

When there is a honey flow on, be sure to inspect the brood chambers of Carniolans; for here again they are usually different from Italians. If they have not enough room in the supers for honey, instead of swarming they will store honey in the brood chamber, or restrict brood laying. This may induce swarming, but even with this handicap they are not so much inclined to swarm as the Italians.

In comparing the various races of bees, it should be remembered that the natural conditions of the native country of the race must have a great influence upon their physical structure and characteristics. If the race comes from a country where all is sunny and calm, and where there is plenty of nectar to be gathered without battling with severe weather conditions, one would not expect to find the race so hardy as those from a mountain region where the conditions are hard, the honey harvests small and gained under very great difficulties and over great distances, and where, in the past centuries, beekeepers did not help artificially to improve the conditions. In such countries, the law of the survival of the fittest operated, and a strong virile race of bees results, and this appears to be what has happened in Carniola. Why this selfsame race should at the same time be so quiet to handle is not so easily explained. It may be that, in their home land, they have not so many enemies to fight against as in some other countries, and, therefore, are more trustful when carefully handled.

A paragraph in "The Bee World" gives an interesting fact:—"That the Austrian Empress Maria Theresia (1740-1780) appointed in 1770 the famous beekeeper of that time, Anton Jansa (pronounced Jansha) from Upper Carniola, to come to the Court as an instructor for beekeeping for Vienna and Lower Austria. Jansa was there only three years, for he passed away in 1773; but in this short time he increased the productiveness of beekeeping amazingly by introducing Carniolan bees, and hives for migratory beekeeping, as the originator of which

he is respected in Austria." The scientific name of these bees is "Apis mellifica Norica," signifying that these bees are found all over the districts of the old Roman province of Noricum, and not only in Carniola, although at the present time the principal breeders are situated in Carniola, which has given them that name. Those bred in Carniola, however, appear to be more distinct, as some of the Noric bees tend towards the leather Italians.

Rottnest Mating Apiary, 1936.

The prices of Carniolan queens are as follow:—

Select tested—20s.

Laying but untested—

1st. 10 queens—7s. 6d. each.

Over 10—1st 10 at 7s. 6d., and next 5 at 3s. each.

Over 15—1st 10 at 7s. 6d., next 5 at 3s., all over 15 at 2s. each.

Three-frame nuclei, with untested queen, food and brood, 32s. 6d. each —freight extra.

The illustrations show two views of Rottnest Apiary and Bee-house, and one of a movable house apiary of Mr. Hochegger, of Styria, containing 40 to 50 colonies of Carniolans.

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## COST OF FEEDING COWS UNDER THE AUSTRALIAN OFFICIAL PURE BREEDS' HERD-RECORDING SCHEME, WESTERN AUSTRALIA, 1935-36.

G. K. Baron-Hay, Superintendent of Dairying and
B. Williams, Agricultural Adviser.

In the following article an attempt has been made to arrive at the value of the various fodders and pastures made available to dairy stock being tested under the official Pure Bred Herd-Recording Scheme.

From the figures obtained the average cost of maintenance and the average cost per unit production of milk and butter-fat has been estimated. In actual practice, the cost per gallon of milk or pound of butter-fat depends not only on the cost of the food consumed but on the value of the land used for grazing,

the value of the cows, the prices realised on the sale of young stock, the cost of labour, and many other factors incidental to the management of a dairy farm.

In arriving at these food costs, the average monthly price of purchased foods has been used in the estimate. The variation in the price of these foodstuffs is small according to season or the district in which they are supplied. When considering home-grown fodders, however, the striking of an average cost price is beset with many difficulties. It is readily seen that the cost of production of green crops and pasture must vary enormously with differences in district, rainfall and soil conditions—perhaps one of the greatest factors is management. In studying the following tables, therefore, the reader must make allowance for his own particular difficulties.

The work of Pure Bred Herd Recording, in addition to the actual testing of the herds, entails the recording of fodders and concentrates fed to stock under test. By this means information is made available to the farmer which may serve as a guide towards the formulation of economic fodder mixtures for milk and butter-fat production.

Table I. shown hereunder indicates the prices used in the subsequent tables.

Table I.

Prices used in valuating the foodstuffs consumed during the year ended 30th June, 1936.

| | £ | s. | d. |
|---|---|---|---|
| Wheaten Chaff, per ton | 5 | 2 | 4 |
| Oaten Chaff, per ton | 4 | 14 | 6 |
| Wheat, crushed, per bushel | | 4 | 0 |
| Oats, crushed, per bushel | | 2 | 7 |
| Bran, per ton | 6 | 4 | 4 |
| Pollard, per ton | 6 | 4 | 4 |
| Silage, per ton | | 10 | 0 |
| Meggitts Meal, per ton | 11 | 10 | 0 |
| Proteena, per ton | 10 | 0 | 0 |
| Cow Meal, per ton | 11 | 4 | 9 |
| Meat Meal, per ton | 13 | 8 | 10 |
| Brewers' Grains, per bushel | 0 | 0 | 5 |
| Potatoes, per ton | 1 | 10 | 0 |
| Meadow Hay, per ton | 2 | 0 | 0 |
| Lucerne, green, per ton | 1 | 0 | 0 |
| Green Maize, Sudan Grass, Cereal Crops, etc. | | | |
| Chaffed, per ton | | 6 | 0 |
| Grazed, per head | | 2 | 6 |
| Pasture, per head, per week | | 1 | 6 |

In Table II., are shown the average results over the past 13 years. It will be seen that a saving of £1 3s. 5d. has been made compared with the results obtained last year. The average price of butter-fat has remained constant. The above decrease in production costs must represent a substantial increase in the net profits obtained—this, of course, implies disregard of the other factors influencing the cost incurred in dairy management. Thus the average cost of food to produce 1 lb. butter-fat has fallen from 7.34 pence to 6.54 pence, a reduction of 10.9 per cent. The average yield of butter-fat per lactation period is only slightly less than the previous year. This is worthy of note as the season experienced by many stud breeders was not so good as in past years and not conducive to the making of record yields.

Table II.

PURE BRED COWS UNDER OFFICIAL TEST.—AVERAGE RESULTS OVER A PERIOD OF 12 YEARS.

| Year ending 30th June. | Average Milk Yield per Cow. | Average Butter Fat Yield per Cow. | Average Cost of Feed per Cow. | Average Cost of Feed to produce 1lb. Butter-fat. | Average Cost of Feed to produce 1 gal. Milk. | Average Value of Butter-fat per lb. |
|---|---|---|---|---|---|---|
| | gals. | lb. | £ s. d. | pence. | pence. | pence. |
| 1924 ... ... | 600 | 319·50 | 10 4 10 | 7·70 | 4·09 | 19·5 |
| 1925 ... ... | 652 | 308·59 | 14 13 2 | 10·77 | 6·15 | 17·5 |
| 1926 ... ... | 624 | 312·01 | 14 14 7 | 11·15 | 5·66 | 19·0 |
| 1927 ... ... | 602 | 290·72 | 14 10 5 | 12·00 | 5·79 | 19·0 |
| 1928 ... ... | 592 | 280·56 | 15 11 4 | 13·34 | 6·34 | 19·5 |
| 1929 ... ... | 629 | 295·10 | 15 1 0 | 12·24 | 5·74 | 20·0 |
| 1930 ... ... | 636 | 294·98 | 14 10 3 | 12·74 | 5·10 | 19·5 |
| 1931 ... ... | 643 | 301·60 | 9 14 7 | 7·74 | 3·64 | 16·0 |
| 1932 ... ... | 696 | 318·96 | 10 18 3 | 8·21 | 3·76 | 14·0 |
| 1933 ... ... | 664 | 308·60 | 9 2 3 | 7·08 | 3·29 | 11·0 |
| 1934 ... ... | 720 | 333·70 | 10 2 6 | 7·28 | 3·37 | 10·0 |
| 1935 ... ... | 682 | 326·61 | 9 18 0 | 7·34 | 3·49 | 12·5 |
| 1936 ... ... | 681 | 320·14 | 8 14 7 | 6·54 | 3·08 | 12·5 |

Table III.

BREEDS COMPARED AS PRODUCERS OF MILK AND BUTTER FAT.

| Breed. | Average Yield of Milk per Cow during 9 months. | Average Test. | Average Yield of Butter-fat per Cow during 9 months. | Average Cost of Feed per Cow. | Average Cost of Feed to produce 1 gal. Milk. | Average Cost of Feed to produce 1 lb. Butter-fat. |
|---|---|---|---|---|---|---|
| | lb. | % | lb. | £ s. d. | d. | d. |
| Jersey (14 herds) ... | 6,069 | 5·47 | 331·80 | 7 2 6 | 2·81 | 5·14 |
| Guernsey (5 herds) ... | 6,225 | 5·15 | 320·88 | 9 16 6 | 3·78 | 7·35 |
| A.I.S. (11 herds) ... | 7,801 | 4·05 | 316·30 | 9 19 6 | 3·20 | 7·58 |

The figures shown in Table III. indicating the cost of production of each breed under test show that there is little to choose between these breeds as regards butter-fat production, the Jerseys leading by a small margin. With regard to the yield of milk obtained, however, the Australian Illawarra Shorthorn shows to advantage.

The cost of production in areas of light rainfall compared with that of the wetter districts, as shown in Table IV., is of interest. As would be expected, the cost is much greater in the drier districts. Perhaps the greatest factor influencing the cost of production is that of pasture establishment. The yield of good pasture under an efficient grazing system is the cheapest form of food available. The conditions experienced by stud breeders, however, are varied, and each district has its own peculiar difficulties with which to contend.

Table IV.

COST IN LIGHT RAINFALL AREAS COMPARED WITH HERDS IN THE SOUTH-WEST.

| Average. | Production. | | Cost of Feed for— | |
|---|---|---|---|---|
| | Milk. | Butter-fat. | 1 gal. Milk. | 1lb. Butter-fat. |
| | lb. | lb. | d. | d. |
| Dry areas (14 herds) ... ... | 7,382 | 328·59 | 3·85 | 8·27 |
| Wet areas (16 herds) ... ... | 6,152 | 309·81 | 2·16 | 4·33 |

The individual results obtained from each herd are shown in Table V. Herds are placed in order of merit as producers of butter-fat. Herd "S," owned by Mr. L. C. Field, of Donnybrook, has the highest average production of butter-fat, and he is to be congratulated upon such a fine record. It will be noticed that the cost of foodstuffs has been kept down to a minimum, despite the high yield obtained. This is due in part at least to the excellent pastures which Mr. Field has established, making the purchase of large quantities of highly priced fodders unnecessary.

TABLE V.

HERDS IN ORDER OF MERIT AS PRODUCERS OF BUTTER FAT.

| Place. | Herd. | District: Wet—W. Dry—D. | Breed. | Average Production of Butter-fat per Cow during 9 months. | Available Skim Milk per Cow. | Value of Butter-fat at 12½d. per lb. | Value of Skim Milk at 1d. per gal. | Gross Return from Butter-fat and Skim Milk. | Cost of Feed per Cow during 9 months. | Profit per Cow by Sale of Butter-fat and Use of Skim Milk. | Cost of Feed to produce 1lb. Butter-fat. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | lb. | lb. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | d. |
| 1 | S | W | Jersey ... | 453·78 | 6,090 | 23 12 8 | 2 10 9 | 26 3 5 | 6 11 9 | 21 11 8 | 3·48 |
| 2 | L | D | do. ... | 383·31 | 5,760 | 19 19 3 | 2 8 0 | 22 7 3 | 14 6 6 | 8 0 9 | 8·98 |
| 3 | D | W | Guernsey ... | 380·61 | 6,790 | 19 16 6 | 2 16 7 | 22 13 1 | 6 1 10 | 16 11 3 | 3·84 |
| 4 | Z | D | A.I.S. ... ... | 371·86 | 8,440 | 19 7 4 | 3 10 4 | 22 17 8 | 8 6 4 | 14 11 4 | 5·34 |
| 5 | M | D | Guernsey ... | 371·07 | 6,170 | 19 6 6 | 2 11 5 | 21 17 11 | 13 2 3 | 8 15 8 | 8·48 |
| 6 | J | W | Jersey ... | 365·18 | 5,880 | 19 0 9 | 2 1 6 | 21 2 3 | 9 15 5 | 11 6 10 | 6·42 |
| 7 | I | D | do. ... | 361·22 | 5,520 | 18 17 1 | 2 6 0 | 21 3 1 | 8 15 1 | 12 8 0 | 5·82 |
| 8 | AB | D | A.I.S. ... ... | 355·91 | 7,300 | 18 10 9 | 3 0 10 | 21 11 7 | 7 10 5 | 14 1 2 | 5·07 |
| 9 | T | W | do. ... ... | 338·94 | 8,130 | 17 13 1 | 3 6 11 | 21 0 0 | 3 8 5 | 17 11 7 | 2·42 |
| 10 | X | D | Guernsey ... | 335·79 | 4,850 | 17 9 9 | 2 0 5 | 19 10 2 | 15 6 3 | 4 3 11 | 10·94 |
| 11 | AA | D | A.I.S. ... ... | 332·93 | 7,140 | 17 6 10 | 2 19 6 | 20 6 4 | 9 18 1 | 10 8 3 | 7·14 |
| 12 | W | W | Jersey ... | 332·58 | 5,260 | 17 6 5 | 2 3 10 | 19 10 3 | 3 6 2 | 16 4 1 | 2·39 |
| 13 | G | D | A.I.S. ... ... | 318·51 | 7,360 | 16 11 11 | 3 1 4 | 19 13 3 | 11 12 1 | 7 11 2 | 8·54 |
| 14 | F | D | do. ... ... | 314·91 | 6,370 | 16 8 0 | 2 13 1 | 19 1 1 | 16 2 5 | 2 18 8 | 12·29 |
| 15 | AD | D | Jersey ... | 307·82 | 5,030 | 16 0 8 | 2 1 11 | 18 2 7 | 13 16 10 | 4 15 9 | 10·79 |
| 16 | V | D | A.I.S. ... ... | 304·11 | 7,200 | 15 16 9 | 3 0 0 | 18 16 9 | 11 5 11 | 7 10 10 | 8·40 |
| 17 | E | W | Jersey ... | 299·66 | 5,080 | 15 12 2 | 2 2 4 | 17 14 6 | 3 9 9 | 14 4 9 | 2·79 |
| 18 | O | W | do. ... | 296·85 | 5,320 | 15 9 3 | 2 4 2 | 17 13 5 | 6 7 0 | 11 6 5 | 5·13 |
| 19 | B | W | do. ... | 295·72 | 5,000 | 15 9 1 | 2 1 8 | 17 10 9 | 5 11 4 | 11 19 5 | 4·50 |
| 20 | Y | W | do. ... | 293·00 | 3,940 | 15 5 3 | 1 12 10 | 16 18 1 | 4 15 4 | 12 2 9 | 3·90 |
| 21 | X | D | A.I.S. ... ... | 287·96 | 6,340 | 15 0 0 | 2 12 10 | 17 12 10 | 11 8 10 | 6 4 0 | 9·54 |
| 22 | AC | W | do. ... ... | 286·69 | 5,860 | 14 18 8 | 2 8 10 | 17 7 6 | 5 5 4 | 12 2 2 | 4·41 |
| 23 | R | W | Guernsey ... | 284·31 | 4,960 | 14 16 2 | 2 1 4 | 16 17 6 | 9 4 0 | 7 13 6 | 7·77 |
| 24 | P | D | Jersey ... | 284·24 | 4,800 | 14 16 1 | 2 0 0 | 16 16 1 | 9 15 0 | 7 1 1 | 8·23 |
| 25 | K | W | do. ... | 280·31 | 6,220 | 14 12 0 | 2 11 10 | 17 3 10 | 7 18 10 | 9 5 0 | 5·42 |
| 26 | Q | D | A.I.S. ... ... | 278·10 | 6,220 | 14 9 8 | 2 11 10 | 17 1 6 | 12 0 9 | 5 0 9 | 10·37 |
| 27 | A | W | Jersey ... | 273·44 | 4,230 | 14 8 0 | 1 15 3 | 16 3 3 | 3 15 4 | 12 7 11 | 3·27 |
| 28 | U | W | Guernsey ... | 258·93 | 4,090 | 13 9 9 | 1 14 1 | 15 3 10 | 5 0 0 | 10 3 10 | 4·69 |
| 29 | C | W | A.I.S. ... ... | 247·68 | 5,710 | 12 18 0 | 2 7 7 | 15 5 7 | 3 1 4 | 12 4 3 | 2·97 |
| 30 | H | W | Jersey ... | 213·12 | 3,370 | 11 2 0 | 1 8 1 | 12 10 1 | 5 5 11 | 7 4 2 | 5·53 |
| Average ... | | | ... ... ... | 320·14 | 5,990 | 16 12 8 | 2 9 11 | 19 2 7 | 8 14 7 | 10 8 0 | 6·54 |

Table VI.

HERDS IN ORDER OF MERIT AS PRODUCERS OF MILK.

| Place. | Herd. | Breed. | Average Yield of Milk per Cow during 9 months. | Value of Whole Milk at 1s. 1½d. per gallon. | Cost of Food per Cow during 9 months. | Profit per Cow over Cost of Food during 9 months. | Cost of Food to Produce 1 gal. Milk. |
|---|---|---|---|---|---|---|---|
| | | | lb. | £ s. d. | £ s. d. | £ s. d. | d. |
| 1 | Z | A.I.S. | 9,314 | 45 17 8 | 8 6 4 | 37 11 4 | 2·14 |
| 2 | T | do. | 8,969 | 44 2 3 | 3 8 5 | 40 13 10 | 1·29 |
| 3 | G | do. | 8,178 | 40 0 0 | 11 12 1 | 28 7 11 | 3·32 |
| 4 | AB | do. | 8,155 | 39 16 10 | 7 10 5 | 32 6 5 | 2·21 |
| 5 | V | do. | 8,000 | 39 1 3 | 11 5 11 | 27 15 4 | 3·19 |
| 6 | AA | do. | 7,971 | 38 14 9 | 9 18 1 | 28 16 8 | 2·98 |
| 7 | D | Guernsey | 7,649 | 37 4 9 | 6 1 10 | 31 2 11 | 1·91 |
| 8 | F | A.I.S. | 7,181 | 34 15 10 | 16 2 5 | 18 13 5 | 5·39 |
| 9 | X | do. | 7,128 | 34 10 7 | 11 8 10 | 23 1 9 | 3·85 |
| 10 | S | Jersey | 7,049 | 34 2 3 | 6 11 9 | 27 11 6 | 2·24 |
| 11 | M | Guernsey | 7,041 | 34 1 3 | 13 2 3 | 20 19 0 | 4·67 |
| 12 | K | Jersey | 7,005 | 33 17 1 | 7 18 10 | 25 18 3 | 2·72 |
| 13 | Q | A.I.S. | 6,998 | 33 17 0 | 12 0 9 | 21 16 3 | 4·12 |
| 14 | J | Jersey | 6,746 | 32 7 8 | 9 15 5 | 22 12 3 | 2·43 |
| 15 | L | do. | 6,642 | 31 19 7 | 14 6 6 | 17 13 1 | 5·18 |
| 16 | AC | A.I.S. | 6,546 | 31 12 10 | 5 5 4 | 26 7 6 | 1·69 |
| 17 | C | do. | 6,462 | 31 0 0 | 3 1 4 | 27 18 8 | 1·14 |
| 18 | I | Jersey | 6,384 | 30 12 6 | 8 15 1 | 21 17 5 | 3·29 |
| 19 | O | do. | 6,110 | 29 12 8 | 6 7 0 | 23 5 8 | 2·49 |
| 20 | W | do. | 6,097 | 29 11 8 | 3 6 2 | 26 5 6 | 1·30 |
| 21 | E | do. | 5,917 | 28 4 7 | 3 9 9 | 24 4 10 | 1·42 |
| 22 | AD | do. | 5,839 | 27 16 3 | 13 6 10 | 14 9 5 | 5·69 |
| 23 | B | do. | 5,794 | 27 2 8 | 5 11 4 | 21 11 4 | 2·27 |
| 24 | N | Guernsey | 5,686 | 27 0 7 | 15 6 3 | 11 14 4 | 5·58 |
| 25 | R | do. | 5,640 | 26 15 5 | 9 4 0 | 17 11 5 | 3·91 |
| 26 | P | Jersey | 5,584 | 26 9 2 | 9 15 0 | 16 14 2 | 4·19 |
| 27 | A | do. | 5,008 | 23 9 9 | 3 15 4 | 19 14 5 | 1·81 |
| 28 | U | Guernsey | 4,841 | 22 12 1 | 5 0 0 | 17 12 1 | 2·51 |
| 29 | Y | Jersey | 4,734 | 22 0 7 | 4 15 4 | 17 5 3 | 2·42 |
| 30 | H | do. | 4,081 | 18 12 11 | 5 5 11 | 13 7 0 | 3·11 |
| Average | ... | ... | 6,810 | 32 17 3 | 8 14 7 | 24 2 8 | 3·08 |

In the above table the leading herd "Z," owned by Mr. W. G. Burges, York, deserves special mention. This herd of Illawarra Shorthorn cows produced an average of 9,314 lbs. of milk in a comparatively "dry" district. This would have been impossible without adequate supplies of good silage, of which approximately 200 tons was conserved.

Table VII.

*Summary of Results During 1935-36 Season.*

The average production of pure bred cows under Official Test:—

(i) 6810 lb. milk.

(ii) 320.14 lb. butter-fat.

| | | £. | s. | d. |
|---|---|---|---|---|
| (i) | Value of Whole Milk at 1s. 1½d. per gallon .. .. | 32 | 17 | 3 |
| | Cost of feed during nine months .. .. .. | 8 | 14 | 7 |
| | Net return by sale of Whole Milk .. .. | 24 | 2 | 8 |
| (ii) | Value of Butter-fat as 12½d. per lb. .. .. .. | 16 | 12 | 8 |
| | Value of Skim Milk at 1d. gallon .. .. .. | 2 | 9 | 11 |
| | Gross return .. .. .. .. .. | 19 | 2 | 7 |
| | Cost of feed during nine months .. .. .. | 8 | 14 | 7 |
| | Net return by sale of Butter-fat and use of Skim Milk .. .. .. .. .. | 10 | 8 | 0 |

# HOW TO FEED YOUR FOWLS.

G. D. Shaw,
Poultry Adviser, Department of Agriculture.

In the Journal of Agriculture of September, 1934—page 442 onwards, we considered the feeding of a pullet for eggs and growth. It is now desirable to consider the next step, that of keeping the egg supply at its highest point, while at the same time seeing that there is no undue strain on the constitution of the birds. One gets quite used to the expressions "too fattening" and "too forcing"; but what do they mean?

No person who studies his birds will fall into the mistake of feeding the wrong class of feed to his stock.

It was mentioned that, "You put into the birds what you want, not what the bird desires." An undue fatness or forcing of a flock is entirely due to mismanagement—wrong feeding—and the blame can only be laid at the door of the person feeding. The fowl has no choice in the matter.

How many have told you that "blacks (Australs) are no good—they go to fat," and yet how many have ever considered that the feed given to the blacks is too fattening?

The three commercial breeds in Western Australia are the Australorps, the Rhode Island Reds and the White Leghorns, totally different in type, shape, size and characteristics. The Austral is naturally a sluggish bird. Its weight makes it so. Being of tame disposition it hangs round the attendant—it is never flighty —matronly—wishing to carry on its work efficiently.

The Rhode Island Red is more active, quite as heavy as the Austral, built differently and needs treating differently.

The White Leghorn is the flighty bird, always on the go, always hunting, snatching—very alert. Yet our industry will try to obtain efficiency from each breed by feeding all on the same rations.

When discussing this problem we must realise that our range of foodstuffs in Western Australia is restricted to wheat, bran, pollard, milk in its various forms such as separated, skimmed, buttermilk and dried buttermilk, meatmeal, bonemeal and perhaps oats and barley, and from these ingredients we must make a balanced diet for our poultry.

All foodstuffs fed to poultry must be sound and wholesome.

The food when consumed performs definite functions and must contain the necessary elements to make and repair tissue—create heat and energy, produce feathers, eggs and body growth.

The feeding values of foodstuffs is determined by the percentage of the various components, such as—

Proteins
Carbohydrates
Fats and Oils
Minerals
Fibre and Moisture.

Protein is a nitrogen-containing food element used for flesh-forming—the building up of waste tissue, and most essential for egg production.

Carbohydrates are made up largely of starch, sugars, gums, etc., which produce heat and energy and form body fats.

Fats and oils are essential heat and energy producing elements, and assist in building up body fats.

Ash is the residue of burnt up foods and contains the minerals necessary for development of bone and feathers, and the formation of egg shell.

Fibre is the outer cells of grains and the fibrous matter in plants, and is not digestible; but a percentage is always present and is necessary to assist digestion.

Moisture in varying proportions is found in all foodstuffs.

Protein is the most expensive ingredient of any feed. It will produce heat and energy, but as a source of heat and energy is too expensive. We therefore concentrate on other ingredients high in carbohydrates and fats when we desire our energy-forming foods. Let us now examine the foods for protein and carbohydrates.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wheat ... ... | contains approx. | 1 | part protein, | 7 | parts carbohydrate and | 12% | moisture. |
| Bran ... ... | „ | „ | 1 | „ | „ | 5 | „ | „ | „ | 8% | „ |
| Pollard ... ... | „ | „ | 1 | „ | „ | 6 | „ | „ | „ | 9% | „ |
| Skimmed and Separated Milk ... | „ | „ | 1 | „ | „ | 2 | „ | „ | „ | 88% | „ |
| Dried Butter Milk | „ | „ | 2 | „ | „ | 3 | „ | „ | „ | | |
| Meatmeal ... ... | „ | „ | 2 | „ | „ | 1 | „ | „ | „ | 9% | „ |

One should realise that the sluggish bird must put on fat if the ration contains an excess of fat and carbohydrates. One should also realise that the active bird can utilise more carbohydrates and fats than the more sluggish breeds. Yet it is the prevailing practice to run both light and heavy breeds together in the one run. It is also the prevailing complaint to hear that, while the heavy breeds get too fat, the light breeds break down.

Go into any yard which contains both heavy and light breeds and handle them. One will notice that if the ration is excellent for the light breeds, the heavy breeds will be over-fat and sluggish.

Go into the yards which feed efficiently for the heavy breeds and you will find that the light breeds are worn out and do not do justice to the breed.

A little intelligent observation will convince any reasonable farmer that something must be wrong, but how many correct this fault? It is generally a condemnation on the breed, not on the person managing the flock.

Even the oldest poultry farmers whose main boast is that they have been feeding fowls for 20 years, etc., will not listen when told that different rations must be fed to birds of different make-up.

One is not of course suggesting that each breed should have a ration all to itself, but one is suggesting that each weight class must have different rations. Heavies one ration, lights another and medium heavies another. When this idea is practised, then and then only will one be successful with all known commerically profitable breeds.

The Light Breed bird is naturally very active, and we do know that activity uses the carbohydrates in the ration.

The heavy breed is naturally sluggish and we should realise that it cannot use all the carbohydrates which are in the ration fed to the lighter breeds.

Therefore, it is only natural that when the farmer admits those opposite characteristics, he will compensate the active breed by the higher proportion of carbohydrates to protein, and that the heavy bird must not receive as great a proportion of carbohydrates as a light breed bird.

If we admit this argument logical, we can then endeavour to manage satisfactorily. If we will not admit those facts we will continue to have mismanagement in feeding.

Let us examine any mixed flock of light and heavy birds. Wave the arm and see the activity of the light breeds—using carbohydrates all the time. The heavy bird will move more slowly. We often complain that White Leghorns are "too

flighty" and we should then realise that their activity allows them to use more carbohydrates than the bird which is "tame."

It was explained that a balanced ration had one portion of protein to about 4.5 portions of carbohydrates and fats.

If the ration is so constituted that it contains one part protein to less than 4.5 carbohydrates, the ration is said to be "narrow."

If the proportion is greater than one part of protein to five parts of carbohydrates the ration is said to be "wide."

It will be noticed that wheat is "wide," but bran is nevertheless nearly balanced. However, bran is useless when fed alone, owing to its bulky nature; yet it is very valuable when used as an essential ingredient giving a vegetable protein. Pollard is "wide," milk is "narrow," and meatmeal exceptionally so. Hence we balance the rations of wheat, bran, pollard, etc., and adding the highly concentrated protein foods (milk and meatmeal) in such a way as to ensure palatability and nutriment sufficient for growth, repair of waste tissues, energy and eggs.

When considering any ration we must concentrate on the dry ingredient basis for all calculations. Moisture is not feed in the true sense. Water is essential but we must never consider it when talking of feed and feeding values.

The rations given on Page 442 and onwards of the September, 1934, Journal of Agriculture are safety rations. When fed to pullets they will give size and production, and any who have had confidence in that ration will naturally enquire when anything goes wrong. Those who do not have confidence in those rations will not enquire for further advice.

Eight parts green feed, 5 parts bran, 3 parts wheatmeal, ½ part meatmeal, (60 per cent. protein) and ¼ part bonemeal—1 part oilcake for morning wet mash, and a dry mash of the same ingredients (leaving out oilcake or greens of course in the dry mash), before them all day, with wheat and greens at evening meal, will prove an excellent ration for light breeds. The pullets will thrive, and the hens will lay plenty of eggs. Generally it is neither too fattening nor too forcing; but when fed to heavies or medium heavies we will have fat birds. The carbohydrates are too great in proportion to the proteins. It is too "wide." We cannot alter the position by cutting down the carbohydrates—that would be starvation, but we can alter it by adding more protein and the only proteins we have in Western Australia are meatmeal and dried buttermilk—nothing else—hence we must add more of the meatmeal and buttermilk (if used).

Our farmer now complains that he must mix three mashes in the morning. He can if he likes work, but he can mix the rations quite easily if he cares to organise. Wet mash in the morning. Dry mash hoppers all day and wheat at night. We can alter our rations in the dry mash hoppers and mix the one wet mash to feed all birds..

It has been found by experiments at Muresk that while the Light Breed could thrive on 5 measures bran, 3 wheatmeal, ½ meatmeal, ¼ bonemeal in both wet and dry mash, the Rhode Island Reds needed ⅝ measure of meatmeal in the dry mash hopper and the Australorps needed 11-16 measure of meatmeal.

By feeding the one wet mash to all breeds, and by altering the dry mash meatmeal proportions to ½ for lights, ⅝ for Rhode Island Reds and 11-16 for Australorps we obtained as near a balanced ration as required for each respective breed.

Let us for a moment assume we are managing a farm containing 400 White Leghorn Pullets, 400 Rhode Island Red Pullets and 400 Austral Pullets—1,200 in all, and quite a good sized farm for one man to manage. We will have 3 or 4

yards of each breed. In the dry mash hoppers we will have the following rations by bulk measurements—not by weights:

| *Lights.* | *R.I.R.* | *Australorps* |
|---|---|---|
| 5 Bran | 5 Bran | 5 Bran |
| 3 Wheatmeal | 3 Wheatmeal | 3 Wheatmeal |
| ½ Meatmeal (60 per cent. protein) | ⅝ Meatmeal (60 per cent. protein) | 11-16 Meatmeal |
| ¼ Bonemeal | ¼ Bonemeal | ¼ Bonemeal |
| ½ Key-meal | ½ Key-meal | ½ Key-meal |

As you cannot easily incorporate oilcake to the dry ration, key-meal can be used by putting in each hopper the proportion of ½ measure.

In the morning—mix 8 greens, 5 bran, 3 wheatmeal, ½ meatmeal, ¼ bonemeal and 1 of oilcake damp measure (or ½ key-meal) as a wet mash and give to all birds.

We will be able to satisfy the appetite of the stock with approximately a 4-gallon tin of wet mash to 100 birds. Any birds that have been eating from the dry mash hoppers will leave and partake of the wet mash.

The hopper mash is now available to all birds, some of which may have been modest—others hungry.

The dry mash hopper is used only by the layer and care must be taken to see that the hopper contains the high protein percentages of the wet mash.

One will notice that the wheat consumed does not reach the 2 oz. figure. This is the ultimate result of the three feed system. The amount used will average about 1½ oz. per bird.

It will thus be seen that the balance is out of proportion to the 2 oz. of mash, to 2 oz. of wheat. This aspect wants to be thoroughly studied. If one works out a balanced ration on the 5 bran, 3 wheatmeal, ½ meatmeal, ¼ bonemeal and ½ keymeal (or 1 oilcake—damp measure) with 2 oz. wheat at night, one will find that the ration is slightly wide, but not wide enough to unduly fatten the light breeds.

The birds by partaking of the dry mash hopper feed, naturally consume more of the mash in proportion to the wheat, and this helps to bring the ratio nearer to 1-4.5 or 1-4.8. Nevertheless, we can overdo it. We must be very careful to see that the wheat portion is kept up to the balance. If the grain feed is not relished by the birds lower the morning portion of mash and add more ground wheat to the dry mash hopper.

We will find, however, that those proportions will certainly fatten both Rhode Island Reds and Australorps. The latter bird more so. Hence the three dry mash rations have been given in order to start on a definite basis.

Having divided the flocks into yards containing only one breed of fowl, it is then a simple matter to feed each breed properly by the correct proportions of protein in the dry mash.

This method will overcome the common complaint that the heavy breeds "get fat." One is only "putting into the birds what one wants, not what the bird wants."

Any fatness should be now confined to those obstinate individuals which will always get fat no matter what one may do. Cull them out.

Let us now proceed to feed the birds on the before-mentioned principles. We have filled the hoppers—let me mention that the hopper need not be an elaborate instrument; even a 6in. deep box will do to start and gradually improve—each hopper containing the separate proportion of proteins desired for the breed to be fed.

In the morning feed the wet mash, in the afternoon at 3.30 feed the grain—an amount they will eat ravenously. Don't leave any over. Then feed the green feed.

Watch the colour of the droppings of each breed—they should be all of the one colour after about a week of feeding this system. It is to the colour of the droppings we must look if we are to find out whether the ration is balanced. No two consignments of food are alike; therefore, unless we compensate the variation in the feed by a variation in the proportions of the ingredients in the feed, the ration will not be consistently balanced. It will vary, and as such it is not satisfactory.

If the colour of all breeds is not even you must vary the proportion of protein in the dry mash, up or down until the colour is even. If one is lighter than the other, put up the percentage of protein in the *dry mash* feed to the birds passing the lighter droppings. Keep adding the percentage *weekly* until all are even in colour.

The colours of the droppings can vary from light yellow to dark brown, to black, then to a slight reddish tinge. Be careful that you are not confusing the colours if you are using charcoal or the soil is of a reddish nature. We must compensate for this, as the birds will consume the charcoal and soil and that will pass through, causing a false colour.

If it is yellow we have too much carbohydrates and fats to protein—the ration is "too wide."

If it is brown this means the same—"too wide."

If it is black-brown we have a ration as near as desired.

If it is black we are near the danger zone.

If it is red bloodish colour we are too narrow, and dangerous.

Aim for the black-brown colour—and satisfaction. Do not consider the white tips—these are urine and are of no importance to our discussion. Simply this—if light brown, too much wheat to meat; if black-brown, O.K.; if reddish, too much meat to wheat. Remedy by varying the meatmeal. It is the highly concentrated protein ingredient and it can influence the ration quickly.

When gauging colour take a quick glance for colour effect. Not an isolated concentration. When the colour is even for all breeds we have found the correct dry mash.

Should the general colour of the droppings of all breeds then lighten up, add more protein to the wet mash; should they generally get too dark lower the percentage.

The principles governing the correct procedure are:

(1) To change the colour of the droppings of an individual breed—alter the percentage of protein in the dry mash.

(2) To change the general colour equally of all breeds, alter the percentage of protein in the wet mash.

One can see that the same principles can be applied to all birds on the farm.

Chickens are fed dry mash for 8 weeks, then wet and dry ever afterwards. Laying pullets the same wet mash with an altered dry mash. Hens the same wet mash—with the alterations in the dry mash. Cockerels, cocks and birds for market, still the same wet mash, but alterations in the dry mash hoppers.

This idea makes feeding definite, at the same time easy. The one wet mash in the mornings—and then only about half the quantity required in comparison to the two feeds a day system, and less wheat or grain at evenings. It cuts down the daily labour. It gives a balanced ration to all breeds. It insures sufficiency of maintenance rations and the requisite amount of egg-forming material. No breed gets overfat. None is worn out, and the egg basket is always full to the highest possible level. We have now definitely worked away from the rule of thumb methods and are applying commonsense feeding.

It is advisable to start immediately and, if doubts are expressed, try one yard of a breed on this system and see the results. More eggs and bigger eggs. The rest of the farm will then have dry mash hoppers installed as soon as possible.

We have only considered the feeding of gristed wheat, bran and whole wheat. When using pollard, one alters the proportions in the mashes to be four pollard and four bran, in place of five bran and 3 wheatmeal. The principles are similar. We also advocate the use of dried buttermilk. When using dried buttermilk, the meat meal must be reduced equivalent in weight to the buttermilk added.

Skimmed, separated or buttermilk can be used with advantage. But one must realise that all liquid forms of milk are so much moisture and so little dry ingredients, and that one cannot substitute four gallons of liquid milk for four gallons of meat-meal. One can only substitute the protein portion of the milk for the same amount in meat meal. The moisture content is very high, and we cannot substitute water for meat meal. When using these milk forms it is safer to use all you can, leave the meat-meal proportion as previously used, and then fluctuate the quantity of meat-meal as designated by the colour of the droppings under the perches.

Rabbits, kangaroos, etc., are not meat-meal—they again are so much moisture and so little protein. They have a low dry matter percentage.

A bird cannot consume enough livers, sheeps' heads, fresh meat—rabbit or kangaroo—to obtain the requisite amount of protein required. The crop and digestive organs are not large enough. But we can use these meats to help reduce the meat-meal. Substitute the fresh meats for a portion of the meat meal by again watching the droppings.

Wheat, of course, is the standard feed on country farms, and wheat is therefore used in all forms—boiled, soaked, gristed and whole. All wheat feeding is satisfactory provided one is assured that the birds obtain the requisite amount of dry matter, irrespective of how the wheat is treated, and that the wheat feeding is balanced with the correct amount of meat-meal and or buttermilk.

One can soak or boil the wheat with skim milk or buttermilk, but one cannot eliminate the dry basis quantities. Meat-meal is still required. The farmer can substitute any grain available in the place of wheat, but he cannot find a substitute for the correct percentage of protein in the ration—he can help with milk in all its forms (except fresh milk), he can assist with animal flesh, but he must still rely on some form of concentrated protein, and we only have the two forms in Western Australia—meat-meal and dried buttermilk.

With the best of management some birds will get fat—these individuals are the exceptional birds which should be "culled." Others again will lose condition—"cull" these also. It is the general condition of a flock which counts, and not any particular bird. Do not starve the flock to reduce fatness. The method of starving to reduce fat is a prevalent practice in the industry and causes lack of condition and loss of production.

If the ration has been wide, the carbohydrates and fats that are not immediately used are stored within the body of the bird as layers of fat. This fat may gradually accumulate until the bird is useless as a laying bird.

We can realise that the only reasonable way to reduce the fat reserve is to make the body demand the use of that extra fat, and to do this one must slightly, but ever so slightly, increase the protein proportion of the ration until the ration is a shade on the "narrow" side. This will then create the demand for more carbohydrates and fats to balance the diet, and so the bird will draw upon the reserve already accumulated for such emergency. This is a long and tedious process. It may be necessary for some special individual birds, but is hardly economical where a flock is affected by overfatness. The surest means is to see that the birds never have access to a ration other than that desired by the farmer.

"Put into the birds what you want." Your birds will then be layers when layers are wanted, and fleshy birds when aiming for table poultry.

## SHEEP DIPPING—A TIMELY WARNING.

HUGH MCCALLUM.
Sheep and Wool Inspector, Department of Agriculture.

Now that the time for the annual dipping of the flock has come it is felt that its importance as a method of checking the ravages of lice and tick must again be stressed. Apart from the compulsory dipping aspect, it is a reflection on good management if every effort is not made towards the eradication of lice and tick in the flock. To travel or expose for sale in a public place sheep which are affected with ticks or lice, becomes an indictable offence for which penalties are provided under the "Stock Diseases Act 1895."

Infested sheep mean financial loss to the stock owner, as affected wool rapidly deteriorates in quality and when opened up ticky fleeces appear thin and dingy and unattractive to buyers.

From the appearance of some of the clips opened up on the show floors it would appear that the sheep tick is very prevalent in certain districts this season, and if allowed to continue lice and tick in sheep must inevitably go from bad to worse. Every person concerned should realise the position and determine on the right lines to stamp out the trouble.

Information regarding dipping, etc., will be supplied free of charge on application in Departmental Leaflets Nos. 153 and 434.

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## FERTILISERS.

N. DAVENPORT,
Inspector of Fertilisers.

In accordance with the Fertilisers Act, 1928, the list of fertilisers registered for the present fertiliser year, which commenced on 1st November, is appended in tabular form.

From the retail prices per ton and the registered fertilising ingredients present in the fertilisers, the unit values for the different forms of nitrogen, phosphoric acid and potash have been calculated and are shown below together with those of 1934-35 and 1935-36 for comparison.

UNIT VALUES.

| | 1934–35. | 1935–36. | 1936–37. |
|---|---|---|---|
| | s. d. | s. d. | s. d. |
| NITROGEN (N) as— | | | |
| Dried Blood, Blood and Bone, Bonedust and Bone and Flesh ... ... ... ... | 22 0 | 22 0 | 21 8 |
| Nitrate ... ... ... ... ... ... | 19 7 | 18 3 | 18 2 |
| Ammonia ... ... ... ... ... ... | 12 3 | 11 8 | 11 3 |
| PHOSPHORIC ACID ($P_2O_5$) as— | | | |
| Water Soluble as Superphosphate ... ... | 3 9 | 3 5 | 3 4 |
| Citrate Soluble as Superphosphate ... ... | 3 9 | 3 5 | 3 4 |
| In Bonedust ... ... ... ... ... | 5 9 | 5 9 | 5 6 |
| In Blood and Bone and other animal fertilisers | 5 3 | 5 9 | 5 6 |
| Basic Phosphate ... ... ... ... | 5 4 | 5 1 | 4 11 |
| Acid Soluble in Superphosphate and Rock Phosphate ... ... ... ... ... | 2 4 | 2 2 | 2 2 |
| POTASH ($K_2O$) as— | | | |
| Sulphate ... ... ... ... ... ... | 6 4 | 6 0 | 6 4 |
| Muriate ... ... ... ... ... ... | 5 0 | 5 0 | 5 6 |

The following fertilisers are registered at the Department of Agriculture under the Fertilisers Act, 1928, for the year commencing 1st November, 1936:—

| Name of Fertiliser. | Brand. | By whom registered. | Nitrogen (N) as: | | | | Phosphoric Acid ($P_2O_5$) as: | | | | Potash ($K_2O$) as: | | Price per ton on rails at Works or Perth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrate. | Ammonia. | Blood & Bone. | Bone-dust. | Water Soluble. | Citrate Soluble. | Acid Soluble. | Total. | Sulphate. | Muriate. | |
| | | | % | % | % | % | % | % | % | % | % | % | £ s. d. |
| **A.—MINERAL.** | | | | | | | | | | | | | |
| 1.—NITROGENOUS. | | | | | | | | | | | | | |
| *(a)—Nitrogen as Nitrate.* | | | | | | | | | | | | | |
| Nitrate of Soda ... ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | 15·5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 0 0 |
| Do. do. ... ... | ML in diamond | do. do. | 15·5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 0 0 |
| Do. do. ... ... | CSML ... ... | do. do. | 15·5 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 0 0 |
| Do. do. ... ... | Cresco ... | Cresco Fertilisers (W.A.), Ltd. | 15·0 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 14 0 0 |
| *(b) Nitrogen as Ammonia.* | | | | | | | | | | | | | |
| Sulphate of Ammonia ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | 20·5 | ... | ... | ... | ... | ... | ... | ... | ... | 11 10 0 |
| Do. do. ... ... | ML in diamond | do. do. | ... | 20·5 | ... | ... | ... | ... | ... | ... | ... | ... | 11 10 0 |
| Do. do. ... ... | CSML ... ... | do. do. | ... | 20·5 | ... | ... | ... | ... | ... | ... | ... | ... | 11 10 0 |
| Do. do. ... ... | ICI ... ... | Nitrogen Fertilisers Pty., Ltd. | ... | 20·6 | ... | ... | ... | ... | ... | ... | ... | ... | 11 10 0 |
| Do. do. ... ... | Cresco ... | Cresco Fertilisers (W.A.), Ltd. | ... | 20·6 | ... | ... | ... | ... | ... | ... | ... | ... | |
| 2.—PHOSPHATIC. | | | | | | | | | | | | | |
| *(a) Rock Phosphate.* | | | | | | | | | | | | | |
| Pacific Island Phosphate .. | Sickle .. . | Cuming Smith Mt. Lyell F.F., Ltd. | ... | . | ... | ... | ... | ... | 36·65 | 36·65 | ... | ... | 4 0 0 |
| Do. do. ... | ML in diamond | do. do. | ... | ... | ... | ... | ... | ... | 36·65 | 36·65 | ... | ... | 4 0 0 |
| Do. do. ... | CSML ... ... | do. do. | ... | ... | ... | ... | ... | ... | 38·65 | 38·65 | ... | ... | 4 0 0 |
| Phosphate Powder ... .. | Cresco .. | Cresco Fertilisers (W.A.). Ltd. | .. | .. | ... | .. | ... | ... | 34·80 | 34·80 | ... | ... | 4 0 0 |
| *(b) Superphosphates* | | | | | | | | | | | | | |
| Florida Super (22%) ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | ... | ... | ... | 20·5 | ·5 | 1·0 | 22·0 | ... | ... | 3 12 6 |
| High Grade Super. (22%) | ML in diamond | do. do. | . | ... | .. | ... | 20·5 | ·5 | 1·0 | 22·0 | ... | ... | 3 12 6 |
| Do. do. ... | CSML ... ... | do. do. | ... | ... | ... | ... | 20·5 | ·5 | 1·0 | 22·0 | ... | ... | 3 12 6 |
| 22 Super. ... ... ... | Cresco ... | Cresco Fertilisers (W.A.), Ltd | ... | ... | ... | ... | 20·5 | ·5 | 1·0 | 22·0 | ... | ... | 3 12 6 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Florida Super. (24%) | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | | | 22·0 | ·5 | 1·5 | 24·0 | | | 3 17 6 |
| High Grade Super. (24%) | ML in diamond | do. do. | | | | 22·0 | ·5 | 1·5 | 24·0 | | | 3 17 6 |
| Do. do. | CSML | do. do. | | | | 22·0 | ·5 | 1·5 | 24·0 | | | 3 17 6 |
| 24 Super. | Cresco | Cresco Fertilisers (W.A.), Ltd. | | | | 22·0 | ·5 | 1·5 | 24·0 | | | 3 17 6 |
| *(c) Rock Phosphates and Superphosphate.* | | | | | | | | | | | | |
| Phosphate Mixture (50/50) | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | | | 10·0 | ·50 | 18·5 | 29·0 | | | 4 1 6 |
| Do. do. | ML in diamond | do. do. | | | | 10·0 | ·5 | 18·5 | 29·0 | | | 4 1 6 |
| Do. do. | CSML | do. do. | | | | 10·0 | ·5 | 18·5 | 29·0 | | | 4 1 6 |
| 50/50 Phosphate | Cresco | Cresco Fertilisers (W.A.), Ltd. | | | | 9·16 | 1·84 | 17·40 | 28·4 | | | 4 1 6 |
| *(d) Basic Phosphate.* | | | | | | | | | | | | |
| Basic Phosphate | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | | | | | 17·0 | 17·0 | | | 4 4 0 |
| Do. do. | ML in diamond | do. do. | | | | | | 17·0 | 17·0 | | | 4 4 0 |
| Do. do. | CSML | do. do. | | | | | | 17·0 | 17·0 | | | 4 4 0 |
| 3.—POTASSIC. | | | | | | | | | | | | |
| *(a) Potash as Sulphate.* | | | | | | | | | | | | |
| Sulphate of Potash | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | | | | | | | 48·6 | | 15 10 0 |
| Do. do. | ML in diamond | Do. do. | | | | | | | | 48·6 | | 15 10 0 |
| Do. do. | CSML | do. do. | | | | | | | | 48·6 | | 15 10 0 |
| Do. do. | Palestinian Potash | George Wills & Co., Ltd. | | | | | | | | 48·0 | | 15 10 0 |
| Do. do. | Sun | Westralian Farmers | | | | | | | | 48·6 | | 15 10 0 |
| Do. do. | Cresco | Cresco Fertilisers (W.A.), Ltd. | | | | | | | | 48·5 | | 14 10 0 |
| *(b) Potash as Muriate.* | | | | | | | | | | | | |
| Muriate of Potash | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | | | | | | | | 50·0 | 14 0 0 |
| Do. do. | ML in diamond | do. do. | | | | | | | | | 50·0 | 14 0 0 |
| Do. do. | CSML | do. do. | | | | | | | | | 50·0 | 14 0 0 |
| Do. do. | Sun | Westralian Farmers, Ltd. | | | | | | | | | 50·0 | 14 0 0 |
| Do. do. | Cresco | Cresco Fertilisers (W.A.), Ltd. | | | | | | | | | 50·0 | 12 10 0 |
| Kainit | Sun | Westralian Farmers | | | | | | | | | 14·0 | † |
| Potash Manure Salts | do. | do. do. | | | | | | | | | 30·0 | † |
| 4.—NITROGEN AND PHOSPHORIC ACID. | | | | | | | | | | | | |
| Super. and Ammonia (No. 1) | Sickle | Cuming Smith F.F., Ltd. Mt. Lyell | | 2·94 | | | 17·57 | ·43 | ·85 | 18·85 | | 5 10 6 |
| Do. do. (No. 2) | do. | do. do. | | 5·15 | | | 15·37 | ·37 | ·76 | 16·50 | | 6 8 0 |
| Do. do. (No. 3) | do. | do. do. | | 6·0 | | | 14·25 | ·40 | 1·10 | 15·75 | | 6 13 0 |
| Do. do. (No. 4) | do. | do. do. | | 6·87 | | | 13·66 | ·34 | ·66 | 14·66 | | 7 1 0 |

† Price not available.

FERTILISERS—*continued.*

| Name of Fertiliser. | Brand. | By whom registered. | Nitrogen (N) as: | | | | Phosphoric Acid ($P_2O_5$) as: | | | | Potash ($K_2O$) as: | | Price per ton on rails at Works or Perth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrate. | Ammonia. | Blood & Bone. | Bone-dust. | Water Soluble. | Citrate Soluble. | Acid Soluble. | Total. | Sulphate. | Muriate. | |
| | | | % | % | % | % | % | % | % | % | % | % | £ s. d. |
| 4.—NITROGEN AND PHOSPHORIC ACID—*contd.* | | | | | | | | | | | | | |
| Super and Ammonia, No. 5 | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | 10·3 | ... | ... | 10·25 | ·25 | ·50 | 11·0 | ... | ... | 8 9 0 |
| Do. do. (No. 1) | ML in diamond | do. do. | ... | 2·94 | ... | ... | 17·57 | ·43 | ·85 | 18·85 | ... | ... | 5 10 6 |
| Do. do. (No. 2) | do. do. | do. do. | ... | 5·15 | ... | ... | 15·37 | ·37 | ·76 | 16·50 | ... | ... | 6 8 0 |
| Do. do. (No. 3) | do. do. | do. do. | ... | 6·0 | ... | ... | 14·25 | ·40 | 1·10 | 15·75 | ... | ... | 6 13 0 |
| Do. do. (No. 4) | do. do. | do. do. | ... | 6·87 | ... | ... | 13·66 | ·34 | ·66 | 14·66 | ... | ... | 7 1 0 |
| Do. do. (No. 5) | do. do. | do. do. | ... | 10·3 | ... | ... | 10·25 | ·25 | ·50 | 11·0 | ... | ... | 8 9 0 |
| Do. do. (No. 1) | CSML ... ... | do. do. | ... | 2·94 | ... | ... | 17·57 | ·43 | ·85 | 18·85 | ... | ... | 5 10 6 |
| Do. do. (No. 2) | do. ... ... | do. do. | ... | 5·15 | ... | ... | 15·37 | ·37 | ·76 | 16·50 | ... | ... | 6 8 0 |
| Do. do. (No. 3) | do. ... ... | do. do. | ... | 6·0 | ... | ... | 14·25 | ·40 | 1·10 | 15·75 | ... | ... | 6 13 0 |
| Do. do. (No. 4) | do. ... ... | do. do. | ... | 6·87 | ... | ... | 13·66 | ·34 | ·66 | 14·66 | ... | ... | 7 1 0 |
| Do. do. (No. 5) | do. ... ... | do. do. | ... | 10·3 | ... | ... | 10·25 | ·25 | ·50 | 11·0 | ... | ... | 8 9 0 |
| Do. do. 1 : 1... | Cresco ... | Cresco Fertilisers (W.A.), Ltd. | ... | 10·0 | ... | ... | 10·25 | ·25 | ·50 | 11·0 | ... | ... | 8 10 0 |
| Do. do. 2 : 1... | do. ... ... | do. do. | ... | 6·87 | ... | ... | 13·66 | ·34 | ·66 | 14·66 | ... | ... | 7 1 0 |
| Do. do. 3 : 1... | do. ... ... | do. do. | ... | 5·15 | ... | ... | 15·37 | ·37 | ·76 | 16·50 | ... | ... | 6 8 0 |
| Do. do. 6 : 1... | do. ... ... | do. do. | ... | 2·94 | ... | ... | 17·57 | ·43 | ·85 | 18·85 | ... | ... | 5 10 6 |
| Potato Manure C ... ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | 3·5 | ... | ... | 16·75 | ·40 | 1·10 | 18·25 | ... | ... | 5 15 6 |
| Do. F ... ... | do. ... ... | do. do. | ... | 6·0 | ... | ... | 14·25 | ·40 | 1·10 | 15·75 | ... | ... | 6 13 0 |
| Do. No. 2 ... | ML in diamond | do. do. | ... | 3·5 | ... | ... | 16·75 | ·40 | 1·10 | 18·25 | ... | ... | 5 15 6 |
| Do. No. 6 ... | do. do | do. do. | ... | 6·0 | ... | ... | 14·25 | ·40 | 1·10 | 15·75 | ... | ... | 6 13 0 |
| Do. C ... ... | CSML ... ... | do. do. | ... | 3·5 | ... | ... | 16·75 | ·40 | 1·10 | 18·25 | ... | ... | 5 15 6 |
| Do. F ... ... | do. ... ... | do. do. | ... | 6·0 | ... | ... | 14·25 | ·40 | 1·10 | 18·25 | ... | ... | 6 13 0 |
| 5.—NITROGEN, PHOSPHORIC ACID AND POTASH. | | | | | | | | | | | | | |
| Special Mixture, No. 67 ... | Cresco .. ... | Cresco Fertilisers (W.A.), Ltd. | ... | 4·00 | ... | ... | 15·00 | ... | 1·00 | 16·00 | 2·40 | ... | 6 12 6 |
| Vine Manure ... ... | do. ... ... | do. do. | ... | 1·50 | ... | ... | 7·10 | 1·40 | 13·50 | 22·00 | 7·50 | ... | 6 15 0 |
| Mixed Manure ... ... | do. ... ... | do. do. | ... | 1·50 | ... | ... | 7·10 | 1·40 | 13·50 | 22·00 | 7·50 | ... | 6 15 0 |
| Orchard Manure ... ... | do. ... ... | do. do. | ... | 1·50 | ... | ... | 7·10 | 1·40 | 13·50 | 22·00 | 7·50 | ... | 6 15 0 |
| Special Orchard Manure ... | do. ... ... | do. do. | ... | 8·34 | ... | ... | 8·40 | ·20 | ·40 | 9·00 | 10·04 | ... | 9 17 6 |
| Potato Manure ... ... | do. ... ... | do. do. | ... | 1·50 | ... | ... | 7·10 | 1·40 | 13·50 | 22·00 | 7·50 | ... | 6 15 0 |
| Potato Special ... ... | do. ... ... | do. do. | ... | 4·00 | ... | ... | 12·50 | ·50 | ·75 | 13·75 | ... | ... | 8 5 6 |
| Potato Manure B ... ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | 3·75 | ... | ... | 14·50 | ·35 | ·75 | 15·60 | 4·50 | ... | 7 1 0 |
| Do. E ... ... | do. ... ... | do. do. | ... | 3·50 | ... | ... | 14·00 | ·30 | ·70 | 15·00 | 8·00 | ... | 7 18 0 |
| Do. G ... ... | do. ... ... | do. do. | ... | 3·50 | ... | ... | 10·50 | ·20 | ·60 | 11·30 | 3·50 | ... | 9 18 6 |
| Do. H ... ... | do. ... ... | do. do. | ... | 4·00 | ... | ... | 12·70 | ·30 | ·70 | 13·70 | 9·00 | ... | 8 7 0 |
| Do. No. 5 ... | do. ... ... | do. do. | ... | 7·50 | ... | ... | 7·00 | ·20 | ·40 | 7·60 | 17·25 | ... | 10 16 0 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Orchard Manure | do. | do. | do. | ... | 2·00 | ... | ... | 15·75 | ·40 | 1·10 | 17·25 | 5·00 | 6 6 0 |
| Special Mixture K | do. | do. | do. | ... | 8·34 | ... | ... | 8·40 | ·20 | ·40 | 9·00 | 10·04 | 9 17 6 |
| Do. KP | do. | do. | do. | ... | 6·34 | ... | ... | 10·50 | ·20 | ·80 | 11·50 | 10·04 | 9 10 0 |
| Tobacco Fertiliser | do. | do. | do. | ... | 3·30 | ... | ... | 14·00 | ·50 | 1·00 | 15·50 | 5·70 | 7 10 0 |
| Potato Manure, No. 3 | ML in diamond | do. | do. | ... | 3·75 | ... | ... | 14·50 | ·35 | ·75 | 15·60 | 4·50 | 7 1 0 |
| Do. No. 4 | do. | do. | do. | ... | 3·50 | ... | ... | 14·00 | ·30 | ·70 | 15·00 | 8·00 | 7 18 0 |
| Do. No. 7 | do. | do. | do. | ... | 3·50 | ... | ... | 10·50 | ·20 | ·60 | 11·30 | 16·00 | 9 18 6 |
| Do. No. 8 | do. | do. | do. | ... | 4·00 | ... | ... | 12·70 | ·30 | ·70 | 13·70 | 9·00 | 8 7 0 |
| Do. No. 5 | do. | do. | do. | ... | 7·50 | ... | ... | 7·00 | ·20 | ·40 | 7·60 | 13·25 | 10 16 0 |
| Orchard Manure | do. | do. | do. | ... | 2·00 | ... | ... | 15·75 | ·40 | 1·10 | 17·25 | 5·00 | 6 6 0 |
| Special Mixture K | do. | do. | do. | ... | 8·34 | ... | ... | 8·40 | ·20 | ·40 | 9·00 | 10·04 | 9 17 6 |
| Do. KP | do. | do. | do. | ... | 6·34 | ... | ... | 10·50 | ·20 | ·80 | 11·50 | 10·04 | 9 10 0 |
| Tobacco Fertiliser | do. | do. | do. | ... | 3·30 | ... | ... | 14·00 | ·50 | 1·00 | 15·50 | 5·70 | 7 10 0 |
| Potato Manure B | CSML | do. | do. | ... | 3·75 | ... | ... | 14·50 | ·35 | ·75 | 15·60 | 4·50 | 7 1 0 |
| Do. E | do. | do. | do. | ... | 3·50 | ... | ... | 14·00 | ·30 | ·70 | 15·00 | 8·00 | 7 18 0 |
| Do. G | do. | do. | do. | ... | 3·50 | ... | ... | 10·50 | ·20 | ·60 | 11·30 | 16·00 | 9 18 6 |
| Do. H | do. | do. | do. | ... | 4·00 | ... | ... | 12·70 | ·30 | ·70 | 13·70 | 9·00 | 8 7 0 |
| Do. No. 5 | do. | do. | do. | ... | 7·50 | ... | ... | 7·00 | ·20 | ·40 | 7·60 | 13·25 | 10 16 0 |
| Orchard Manure | do. | do. | do. | ... | 2·00 | ... | ... | 15·75 | ·40 | 1·10 | 17·25 | 5·00 | 6 6 0 |
| Special Mixture K | do. | do. | do. | ... | 8·34 | ... | ... | 8·40 | ·20 | ·40 | 9·00 | 10·04 | 9 17 6 |
| Do. KP | do. | do. | do. | ... | 6·34 | ... | ... | 10·50 | ·20 | ·80 | 11·50 | 10·04 | 9 10 0 |
| Tobacco Fertiliser | do. | do. | do. | ... | 3·30 | ... | ... | 14·00 | ·50 | 1·00 | 15·50 | 5·70 | 7 10 0 |
| Do. No. 2 | do. | do. | do. | ... | 3·70 | ... | ... | 13·20 | ·30 | ·70 | 14·20 | 7·00 | 7 14 0 |
| Potato Manure B | Swan | Binney & Son | ... | ... | 3·50 | ... | ... | 13·50 | ... | 1·50 | 15·00 | 8·00 | 7 17 6 |
| Do. C | do. | do. | ... | ... | 3·30 | ... | ... | 15·00 | ... | 1·50 | 16·50 | 4·25 | 7 5 0 |
| Orchard High Grade | do. | do. | ... | ... | 8·34 | ... | ... | 8·40 | ... | ·60 | 9·00 | 10·00 | 9 17 6 |
| **6.—MISCELLANEOUS.** | | | | | | | | | | | | | |
| Sulphate of Iron | Sickle | Cuming Smith F.F., Ltd. | Mt. Lyell | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8 10 0 |
| Do. | ML in diamond | do. | do. | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8 10 0 |
| Do. | CSML | do. | do. | ... | ... | ... | ... | ... | ... | ... | ... | ... | 8 10 0 |
| Super. and Manganese * | Cresco | Cresco Fertilisers (W.A.), Ltd. | | ... | ... | ... | ... | 17·00 | ·50 | 1·00 | 18·50 | ... | 7 10 0 |
| **B.—ORGANIC.** | | | | | | | | | | | | | |
| *(a)—Blood and Bone.* | | | | | | | | | | | | | |
| Blood and Bone | Sickle | Cuming Smith F.F., Ltd. | Mt. Lyell | ... | ... | 5·00 | ... | ... | ... | 15·00 | 15·00 | ... | 9 10 0 |
| Do. | ML in diamond | do. | do. | ... | ... | 5·00 | ... | ... | ... | 15·00 | 15·00 | ... | 9 10 0 |
| Do. | CSML | do. | do. | ... | ... | 5·00 | ... | ... | ... | 15·00 | 15·00 | ... | 10 0 0 |
| Do. "G" | do. | do. | do. | ... | ... | 6·00 | ... | ... | ... | 12·00 | 12·00 | ... | 10 0 0 |
| Do. | Apollo | J. Kitchen & Sons | | ... | ... | 5·25 | ... | ... | 3·00 | 12·00 | 15·00 | ... | 9 10 0 |
| Do. | Wyndham | Wyndham Meat Works | | ... | ... | 6·00 | ... | ... | 8·50 | 7·75 | 16·25 | ... | 9 5 0 |
| Do. | A1 | Haynes & Clements | | ... | ... | 5·25 | ... | ... | 3·00 | 9·00 | 12·00 | ... | 11 0 0 |
| Do. | Eclipse | W.A. Meat Exports Co. | | ... | ... | 6·00 | ... | ... | ... | ... | 12·00 | ... | 8 15 0 |
| Do. | Cresco | Cresco Fertilisers (W.A.), Ltd. | | ... | ... | 5·50 | ... | ... | ... | ... | 14·00 | ... | 9 10 0 |
| Do. | Imperial | W. Angliss & Co. | | ... | ... | 5·25 | ... | ... | 5·00 | 11·00 | 16·00 | ... | 9 12 6 |
| Do. | Sun | Westralian Farmers, Ltd. | | ... | ... | 5·25 | ... | ... | ... | 14·00 | 14·00 | ... | 8 5 0 |
| Do. | Star | Binney & Son | | ... | ... | 5·25 | ... | ... | ... | 14·00 | 14·00 | ... | 9 5 0 |
| Do. | Cockbills | Harrold & Murray | | ... | ... | 5·25 | ... | ... | 3·00 | 9·00 | 12·00 | ... | 10 10 0 |
| Do. | A.N.A. Surprise | C. A. Kirkby & Sons | | ... | ... | 5·00 | ... | ... | 4·00 | 10·00 | 14·00 | ... | 10 5 0 |

* Contains 5·75% manganese as $MnO_2$.

FERTILISERS—*continued.*

| Name of Fertiliser. | Brand. | By whom registered. | Nitrogen (N) as: | | | | Phosphoric Acid ($P_2O_5$) as: | | | | Potash ($K_2O$) as: | | Price per ton on rails at Works or Perth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitrate. | Ammonia. | Blood & Bone. | Bonedust. | Water Soluble. | Citrate Soluble. | Acid Soluble. | Total. | Sulphate. | Muriate. | |
| | | | % | % | % | % | % | % | % | % | % | % | £ s. d. |
| *(b) Bones.* | | | | | | | | | | | | | |
| Bonedust ... ... ... | Eclipse ... | W.A. Meat Export Co. ... | ... | ... | ... | 3·5 | ... | ... | 22·00 | 22·00 | ... | ... | 7 10 0 |
| Do. ... ... | W in diamond | Henry Wills & Co. Ltd. | ... | ... | ... | 2·75 | ... | 6·00 | 13·00 | 19·00 | ... | ... | 9 0 0 |
| Do. ... ... ... | CSML ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | ... | ... | 3·50 | ... | ... | 22·00 | 22·00 | ... | ... | 11 0 0 |
| Pure Bonedust ... ... | Cresco ... | Cresco Fertilisers (W.A.), Ltd. | ... | ... | ... | 3·50 | ... | ... | 22·00 | 22·00 | ... | ... | 11 0 0 |
| Bonedust ... ... ... | Swan ... ... | Binney & Son ... ... | ... | ... | ... | 3·50 | ... | ... | 22·00 | 22·00 | ... | ... | 8 15 0 |
| *(c) Blood.* | | | | | | | | | | | | | |
| Dried Blood ... ... | Imperial ... | W. Angliss & Co. (Aust.), Ltd. | ... | ... | 12·00 as dried blood | ... | ... | ... | ... | ... | ... | ... | 13 0 0 |
| C.—MINERAL AND ORGANIC. | | | | | | | | | | | | | |
| Bone and Super. ... ... | Sickle ... ... | Cuming Smith Mt. Lyell F.F., Ltd. | ... | ... | ... | 2·00 | 13·00 | ·80 | 4·70 | 18·50 | ... | ... | 6 12 6 |
| Do. ... ... | ML in diamond | do. do. | ... | ... | ... | 2·00 | 13·00 | ·80 | 4·70 | 18·50 | ... | ... | 6 12 6 |
| Do. ... ... | CSML ... ... | do. do. | ... | ... | ... | 2·00 | 13·00 | ·80 | 4·70 | 18·50 | ... | ... | 6 12 6 |
| Bone, Super and Potash ... | Cresco ... | Cresco Fertilisers (W.A.), Ltd. | ... | ... | ... | 1·00 | ... | ... | 14·00 | 14·00 | 1·00 | ... | 4 17 6 |
| B.S.P. ... ... ... | Swan ... ... | Binney & Son ... ... | ... | ... | ... | 1·10 | 5·00 | ... | 9·00 | 14·00 | ... | 1·20 | 5 0 0 |
| Do. No. 2 ... | do. ... | do. ... ... | ... | ... | ... | 2·00 | 5·00 | ... | 9·00 | 14·00 | ... | 1·20 | 5 12 0 |
| Do. No. 3 ... ... | do. ... ... | do. ... ... | ... | ... | ... | 3·00 | 5·00 | ... | 9·00 | 14·00 | ... | 1·20 | 6 4 0 |
| Do. No. 4 ... ... | do. ... ... | do. ... ... | ... | ... | ... | 4·00 | 5·00 | ... | 9·00 | 14·00 | ... | 1·20 | 6 16 0 |
| Do. No. 5 ... ... | do. ... ... | do. ... ... | ... | ... | ... | 1·10 | 5·00 | ... | 9·00 | 14·00 | ... | 5·00 | 6 10 0 |
| Orchard High Grade (Bone Basis) | do. ... ... | do. ... ... | ... | ... | ... | 8·34 | ... | ... | 9·00 | 9·00 | 10·00 | ... | 10 0 0 |
| Potato Fertiliser A ... | do. ... | do. ... ... | ... | ... | ... | 4·25 | 9·00 | ... | 7·50 | 16·50 | 5·00 | ... | 9 0 0 |
| Fertos ... ... ... | Floreat ... | T. S. McGill ... ... | ... | 9·38 | ... | ... | 15·00 | ·50 | 1·55 | 17·05 | ... | ... | 20 0 0 |
| Domestic Garden ... ... | Wondergrowth | J. W. Matthews ... | ... | ... | ... | 3·75 | 12·00 | ·30 | 3·20 | 15·50 | ... | ... | † |
| Manurial Insecticide ... | Kill-A-Mite ... | Kill-A-Mite Co. ... | ... | ... | ... | 2·02 | ... | ... | 3·76 | 3·76 | ... | 2·51 | † |

† Price not available.

# DYSENTERY IN BEES.

H. Willoughby Lance, Apiculturist.

Since writing the article on the "Diseases of Bees," information has come to hand on investigations of "Dysentery of Bees" by E. C. Alfonsus, Ph.D.

Dysentery usually comes in the spring, or after the bees have been confined to their hives for a period.

Bees are clean insects and will not under normal conditions void their faeces within the hive, hence the very noticeable sign of dysentery, yellow or brown spots on the alighting board and the hive.

Fig. 1.—Upper Bee, dysenteric. Lower Bee, healthy. Note the soiled wing on the dysenteric bee.

—*From "Gleanings in Bee Culture."*

When the bees are confined to the hive the faeces in the rectal sac accumulate until the bees are unable to withhold defecation and the faeces are voided within the hive, combs as well as bees being soiled, and if still unable to take a flight owing to winter confinement, or other causes, dead bees begin to gather round the entrance. Dysenteric bees when able to take a flight appear dull and sluggish, often unable to fly. In a resting position they are not able to hold their hind legs in a normal position, but below, instead of at the side of the abdomen, which is noticeably swollen. (See Fig. 1.)

Unsuitable honey or pollen has usually been considered to be the cause of the dysentery. E. C. Alfonsus therefore decided to investigate in this direction, as he considered that any substance in the stores not digested by bees would

cause dysentery by accumulating in the rectal sac and quantative analysis of the stores, and of the faecel residue of dysenteric bees was undertaken.

For the purpose of this investigation, for two seasons twenty groups, each of two colonies, were wintered on stores of known composition, either honeys or prepared foods. The faeces were analysed, and their weight in relation to the body weight of the bees ascertained.

In the case of dysenteric bees this was 33.9 to 39.4 per cent., but in the case of normal bees only 7.3 to 13.8 per cent. Dry matter was only a small proportion of the weight, the greater portion being moisture. This showed that the excessive quantity of faeces in dysenteric bees was due to moisture.

During the winter it was noticed that some colonies, especially the dysenteric ones, had a considerable quantity of honey crystals collected at the entrance.

Two colonies with an abundance of stores at their disposal suffered from dysentery and finally died of starvation. On examination it was found that the stores had crystallised, the bees had fed on the diluted portion until nothing was left except the crystals, which the bees were unable to utilise. (See Fig. 2.)

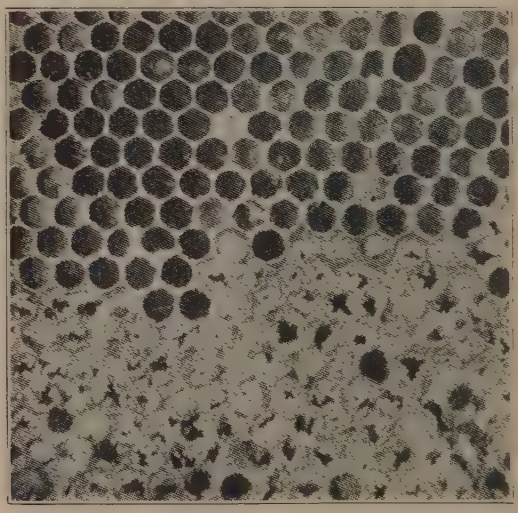

Fig. 2.—Stores with an appearance like the above are frequently found in dysenteric colonies. The liquid honey has been consumed and only crystals and granules are left.

—*From "Gleanings in Bee Culture."*

When honey crystallises the dextrose sugar is the portion that crystallises; the levulose sugar and other substances remain liquid and fill in the space between the crystals, and have a much higher moisture content than the dextrose, which has in comparison very little.

During the second season, the investigations were confined, comparing the excess moisture in relation to dysentery.

Colonies fed on crystallised stores suffered from dysentery, as did those fed, whilst confined, on sugar syrup of the proportion of 50 of sugar and 25 of water.

A candy diet of 10 per cent. moisture did not produce dysentery. Water fed to colonies with crystallised stores increased the disease.

The weight of the faeces was measured and found to be as much as 48.6 per cent. of the weight of whole bees, and some of the faeces contained as much as 86 per cent. moisture.

The conclusion to be arrived at from these investigations, and other information and observation, appears to be that over-diluted foods, feeding in excess, or water consumption under certain unfavourable conditions will bring about dysentery. Over-diluted feed may be caused by the bees feeding on granulated or crystallised honey, consuming the levulose with its excess moisture and being compelled to leave the dextrose crystals; by stores obtained by the bees from fruit juices; by unripe and uncapped honey; both of which when exposed to a humid atmosphere would absorb moisture from the air, thus causing more severe symptoms as time passed on.

Sweating inside the hives, or leaky hives, will cause a humid atmosphere, and the bees in their endeavour to remedy the trouble may consume the moisture deposited on the hive, frames and combs. Hives placed in damp and shady places will contain a higher percentage of moisture inside than those in warm dry places. Only recently an instance of this has occurred in South Australia. A bee keeper writes on "Spring Dwindling": The bees were wintered behind a thick hedge and amongst thick growth. It was noticed that the bees were dwindling, and on examination it was found that there was excess moisture in the hive. The excessive growth was removed so that the sun could play on the hives; excess combs were removed and the bees made snug, and they were also fed once or twice a week with warm syrup; this overcame the trouble. Various other instances and methods are mentioned. This, however, is the point—he states—"On some honeys the bees scour very badly, especially after a long wet winter, and on the first warm day come out and make an awful mess of the hive. Again the clean dry hive and the removal of all combs not in use, coupled with a stimulating syrup work wonders." He evidently had dysentery but called it "Spring Dwindling." Spring Dwindling may be due to several causes. A frequent one unnoticed by bee keepers is dysentery.

*Precautions.*

Do not allow bees to have granulated stores for the winter. See that hives are sound and water tight. Place the hives in *high, warm, and dry situations.*

If the district generally has a moist atmosphere, remove surplus combs and close up the hives until the bees require more space. Make the bees snug.

*Remedies.*

Examine, and if stores are granulated remove all such, giving the bees capped combs of liquid honey if available; also stimulate with one or two lbs. of warm syrup twice a week. If no stores of liquid honey are available, feed rapidly for about a week, then twice a week with warm syrup.

If the cause is excessive moisture, remedy this by making the hives water tight, and removing them to a high, dry and warm situation, closing them up and making snug, and feeding with stimulating syrup.

# THE RED AND BROWN HARD-PAN SOILS OF THE ACACIA SEMI-DESERT SCRUB OF WESTERN AUSTRALIA.

By L. J. H. Teakle, Department of Agriculture.

The conception of zonal soil types, extensive groups of similar soils formed under similar climatic conditions, was evolved by Russian investigators toward the end of the nineteenth century. The application and extension of the principles first enunciated by European workers have led to the formulation of a world-wide system of soil classification which is based on the observed characters of the soils and not on any assumed forces involved in the soil development. The result is the universal recognition of a number of soil types of world-wide distribution; for example, the podsols, or soils with a bleached ash-like layer under the surface humus, and the tshernosems or black soils. There has been a tendency on the part of pedologists, enthusiastic to apply the new system, to make use of the European nomenclature in the mapping of soil zones in other continents and this tendency has led to a number of interesting and, at times, amusing anomalies. However, a number of investigators have introduced new types and it is felt that this represents a service to soil science. Thus, Prescott (1931, 1933), in his work on the soils of Australia made full use of the established nomenclature, but found it necessary to define a new major soil type. This is a grouping of brown and grey, more or less solonised soils typically of the "mallee" vegetation belt of Australia, and is known as the "mallee" soil type. While this group assumes zonal dimensions in Australia, it is probable that localised areas occur in other continents. The solonetz soils of North Dakota, described by Kellogg (1934), resemble rather closely certain representatives of the "mallee" soil zone in Western Australia.

The object of the present paper is to suggest a further major soil type for Australia. In his papers on the soils of Australia, Prescott, *loc. cit.*, has included the central and central eastern portion of Western Australia in the *desert steppe* zone. More recent investigations suggest that portion of this zone has certain characteristics which warrant the definition of a new soil type. The soils in question have not formed under steppe conditions, judging from present vegetation, and are characterised by a very definite profile. This consists of a surface horizon, red to brown in colour, and a more or less undifferentiated sand to sandy clay loam with respect to texture, resting on a light brown to red extremely hard, laminated hardpan. The hardpan may be quite thin in places, but is often many feet in thickness. It appears to be typically non-calcareous, but in some instances lime accumulation may be observed at shallow depths, generally within a few inches of the surface of the hardpan, particularly in areas fringing the "mallee" zone.

Likewise the vegetation is characteristic and is generally referred to collectively as "mulga" in popular parlance, or as "Acacia Semi-desert Scrub" in the terms of the botanist. "Mulga" comprises a number of species of Acacia characterised by grey to grey brown glaucous leaves and ranging from 10 ft. to 20 ft. in height. Representative species include Sugar Brother (*A. aneura*) Bogada Bush (*A. linophylla*), Curara (*A. genistoides*). *A. Burkittii*, etc., Eucalypts are not common, but are represented by a number of species including River Gum (*E. rostrata*) and Coolibar (*E. microtheca*) on areas liable to flooding and Bloodwood (*E. lamphrocarpa*), *E. oleosa*, and Desert Gum (*E. Eudesmoides*). A wide variety of shrubs and other stunted trees also occur.

It is proposed that this major soil type be designated *red and brown hardpan soils*, of the Acacia semi-desert scrub.

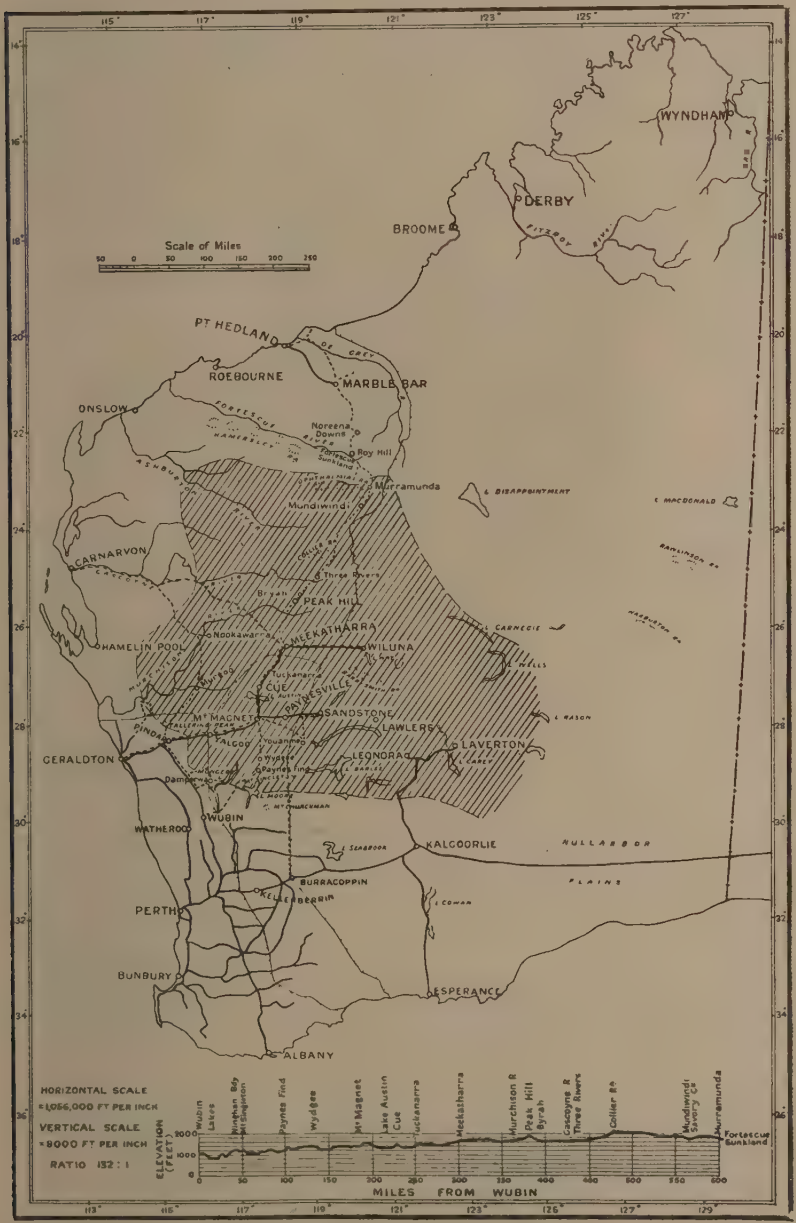


Figure 1.

Map of Western Australia showing the location of the red and brown hardpan soils of the Acacia semi-desert scrub.

The section at the bottom of the map is based on aneroid readings.

The broken lines show the route of traverses made by the author. ----------

Hardpan soils have been described in other parts of the world, for example, the "murram" and "ilepa" soils of Africa, but the literature shows these to be sesquioxidic in nature. Calcareous hardpans are common in other soil types of low rainfall areas. While at first sight the hardpan of these Western Australian soils may appear to be ferruginous in nature, treatment with concentrated hydrochloric acid shows the iron to be merely a deposit on a matrix which is probably cemented by silica.

The known occurrence in Western Australia of the red and brown hardpan soils as the principal zonal soil type is shown in Figure 1. The area is at least 200,000 square miles.

Professor Prescott (private communication) does not know of the occurrence of this soil type in South Australia or New South Wales.

*The Climate.*

It is always a matter of considerable difficulty to represent the climatic conditions of an area. In the present instance it has been possible to record the rainfall, temperature, saturation deficit and the Meyer ratio, and it is considered that these factors give a reasonably accurate definition of the climate. The rainfall and temperature records are familiar to all, but the saturation deficit and Meyer ratio may need some explanation.

The saturation deficit (s.d.) is calculated from humidity of the atmosphere and the temperature, and is found to give a fairly good measure of the evaporating power of the air. (Prescott, 1934, p. 56.) For Western Australian stations the saturation deficit multiplied by 300 is approximately equal to the annual evaporation in inches from a free water surface in a standard evaporimeter. This figure, therefore, is an index of the atmospheric conditions under which the soil is forming and the vegetation association persists.

Another factor expressing the climatic conditions is the Meyer ratio or Precipitation: saturation deficit quotient which is obtained by dividing the annual rainfall in inches by the mean annual saturation deficit in inches of mercury. There is a general relationship between the magnitude of this factor (P: s.d. quotient) and the soil characteristics and a classification of soils on this basis has been studied in Europe and America. This work has been extended to Australia by Prescott (1931) but it is evident that the European and American grouping cannot be regarded as entirely satisfactory for Australia, from the agricultural point of view. This is probably due to the winter incidence of our rainfall, associated with mild temperatures in the southern portion of the continent.

In presenting the P: s.d. quotient figures it was considered advisable to use this value as an index of the conditions month by month. To do this the monthly rainfalls, multiplied by 12 to bring an annual basis, were divided by the respective saturation deficits for the months.

The information concerning the climatic conditions was obtained from C.S.I.R. (Australia) Pamphlet No. 42. 1933, and from the Divisional Meteorologist in Perth. In its various forms it is presented in Tables 1, 2, 3 and 4. Tables I. and II. of the appendix and illustrated in Figure 3.

(a) *The Rainfall*:

The average annual rainfall is about 10 inches or less and is of both summer and winter incidence. In fact, the zone lies as a buffer between the summer rainfall belt of the north and the winter rainfall belt of the south; consequently the northern stations, *e.g.*, Mundiwindi, show a predominately summer incidence, and the southern areas are in the winter rainfall belt.

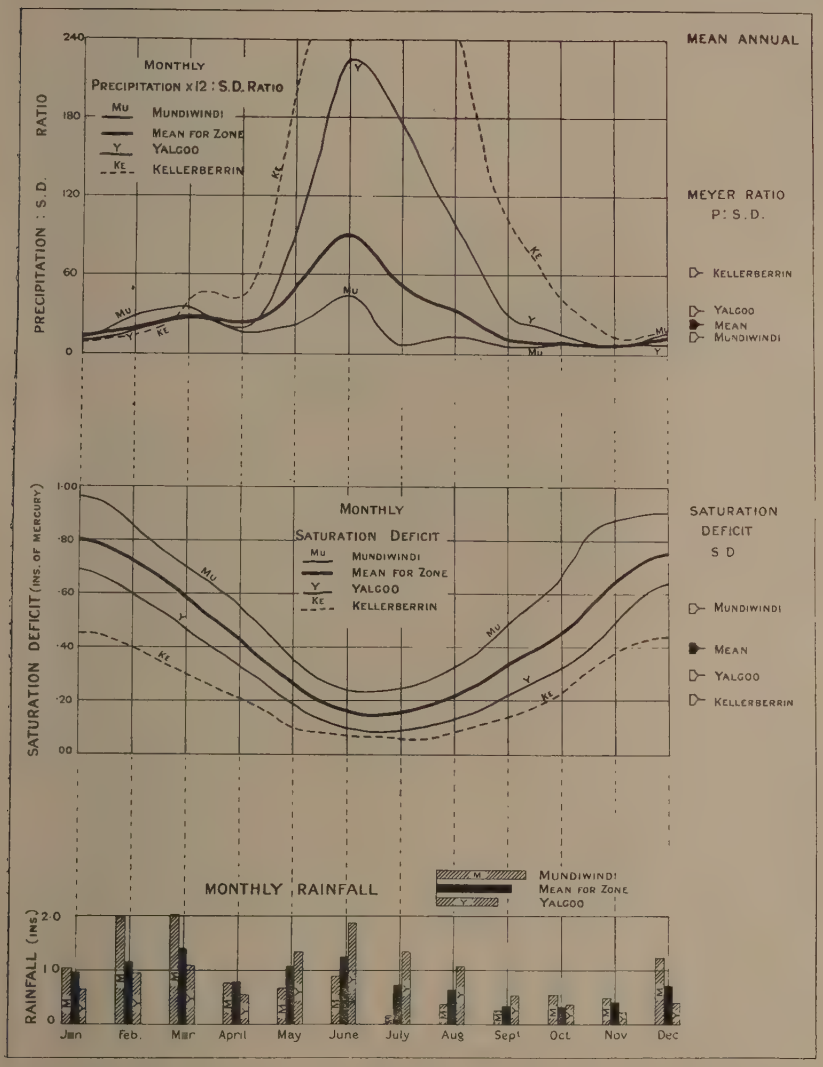


Figure 3.

Illustration of the climatic conditions of the red and brown hardpan soil zone showing—

(a) monthly rainfall,
(b) monthly and mean annual saturation deficits,
(c) monthly and mean annual precipitation: saturation deficit ratios.

In each case the mean for all stations in the zone is given and the curves for Mundiwindi (representing the more tropical conditions) and Yalgoo (representing conditions approaching the "Mallee" zone) are shown for comparison. In the case of "b" and "c" the curves for Kellerberrin, a typical "mallee" zone station, are drawn.

To place the monthly precipitation saturation deficit ratios on the same basis as the Meyer Ratio for purposes of comparison, the monthly precipitation figures are multiplied by 12 before determining the ratio.

Furthermore, the rainfall is not regular in its incidence. A considerable proportion of the low annual precipitation falls in periodic heavy rain-storms over a period of a few days and one fall may affect the monthly average or even the annual average for many years. The nature of these falls is illustrated in Tables I. and II. of the Appendix. Some idea of conditions following such rains may be gauged from the report of the Divisional Meteorologist for April, 1900:—

> "This month will be long remembered as the month of the great floods. These were so severe that telegraph lines were interrupted for weeks, and the postal service in the interior was completely demoralised. The extensive dry plains were converted into inland seas or lakes, and the rivers became raging torrents. Peak Hill and Wiluna stations situated in the great inland desert, were completely cut off from all food supplies, and there was talk of holding a regatta at the latter place, where a boat could sail a course of 70 miles. The rainfall was of a monsoonal character, and travelled from the north-west coast, in a more or less south-easterly direction, towards the head of the Great Australian Bight. It may be said to have first set in on the 2nd of March, a detailed account of a heavy storm being given in notes of March. After the main storm passed away, the weather continued unsettled, with occasional showers throughout the remainder of the month. Rain commenced in earnest on the 1st April, and from then till the 20th a dense cloud-bank enveloped nearly the whole of Western Australia, and the rain was almost incessant.
>
> "We have, unfortunately, but scanty records from which to make a comparison with past years, but from all that can be gathered, this fall was the heaviest, most general, and most persistent ever known, and no man living ever saw the country flooded to the same extent."

The recordings at Wiluna in that month (April) totalled 20.75 inches which fell in 20 days. The same month Cue recorded 8.32 inches; Laverton, 8.05 inches; Peak Hill, 8.25 inches; and Lawlers, 7.99 inches.

Apparently similar floods occurred in portions of the area in March, 1934, when records of 8 to 10 inches were common and the broad valleys were under water for miles. Three Rivers, 10.57 inches; Mundiwindi, 8.36 inches.

It is considered that these heavy falls, associated with conditions of restricted drainage and slow run-off, constitute an important factor in the soil forming processes which have resulted in this peculiar profile under consideration.

The variability of the rainfall has been studied by Barkley (1931) who shows that the average variation from the mean in the area included in the red and brown hardpan soil zone ranges from 30 to 35 per cent. in the southern and central areas to 60 per cent. in the North-west.

*(b). Temperatures.*

The mean annual temperature of the zone ranges from 60 degrees F. to 73 degrees F. (Table 2). The winters are cool and bracing, but the summer months are hot, maximum daily temperatures in excess of 100 degrees F. being common.

*(c). Humidity.*

Extreme dryness is a characteristic of the greater portion of the year, a fact illustrated by the saturation deficit, (Table 3), which averages 0.4 inches of mercury for the year. Records from Laverton show a mean annual evaporation of 142 inches (Jutson, 1934,—P.12) and it is probable that, in general, the mean annual evaporation ranges from about 7½ feet in the south to nearly 15 feet at Mundiwindi. These figures appear more significant when it is remembered that the average annual rainfall is only 10 inches.

*Discussion of Climatic Conditions.*

The Stations selected to represent the red and brown hardpan soil zone show a range in climatic conditions from Yalgoo in the south-west to Mundiwindi in the north-east. Yalgoo approaches more nearly to the stations in the more temperate regions represented by Watheroo and Kellerberrin, and Mundiwindi to the more tropical conditions of the north.

Furthermore it will be noted that while Carnarvon, Watheroo and Kellerberrin receive a winter rainfall with a single maximum in the months May to August (May to July for Carnarvon) the monthly averages for stations in the red and brown hardpan soil zone show a wider spread in the distribution of the rainfall and the data exhibit two maxima and two minima. The maxima are January-March and May-June and the minima are April and July-December.

The mean annual saturation deficit is 0.40 inches of mercury. Taken by seasons, the air is driest in January when the average saturation deficit is 0.80 inches and most moist in June when the deficit amounts to 0.16 inches of mercury (Table 3). As the average annual rainfall is only 10 inches, the usual conditions are arid and the soil is subjected to long periods of desiccation with occasional and infrequent periods of saturation. The precipitation saturation deficit ratios show that, on the average, the soil moisture content is above the wilting point of plants during only one month (June) of the year. (Prescott, private communication.)

Expressed in another way, the average saturation deficit of 0.40 inches of mercury means that 5.44 inches of water or approximately 550 tons per acre, would be required to saturate the atmosphere with water vapour. At Mundiwindi, in the month of January, the saturation deficit amounts to 0.96 inches of mercury. This is equivalent to 13 inches of water, which is considerably in excess of the annual precipitation.

The facts, combined with the high temperatures, lead to the establishment of a xerophytic vegetation with ephemerals which flourish after rains. Perennial grasses are more common in the northern areas of more generous summer rains and herbs, largely composites, predominate the south, where the winter incidence of the rain is more marked.

The Meyer ratio (Table 4) is low and averages only 23.8. This brings the zone into the "desert" class of the European and American investigators. It is thought that the vegetation association established is largely responsible for the area being useful pastoral country and not "desert" in the usual sense of the term. The necessity for preserving this vegetation at all cost needs no emphasis.

For purposes of comparison, the tables and figures include information regarding Carnarvon where the coastal influence has tempered the summer climate and also regarding Watheroo and Kellerberrin of the "mallee" zone or, more specifically, the wheat belt. The stations in the "mallee" zone, Watheroo and Kellerberrin, show far less aridity than the red and brown hardpan soil zone. The temperatures are lower throughout the year (Kellerberrin and Watheroo show practically identical temperature curves), the saturation deficit is significantly lower, the rainfall is higher and more seasonal. It is understandable, therefore, that the soil and the vegetation of the red and brown hardpan soil zone differ greatly from that of the "mallee" zone.

*Physiography and Geology.*

Jutson, (1934), has described briefly the geology and physiography of the area in his discussion of the Murchisonia and Salinaland Divisions. This physiographic subdivision is made on the basis of drainage features and does not apply to the soil or vegetation associations.

The western portion of the red and brown hardpan soil zone is characterised by sedimentary deposits of the Tertiary, Jurassic and Carboniferous periods with more or less horizontal bedding; east of these, the rocks are Pre-Cambrian; in the north, the Nullagine, the Mosquito Creek and the Warrawoona series occur (mainly sediments, lava flows and some granites), and in the south, granites, with small patches of greenstone, predominate.

The area is the residual of an ancient plateau continuous with the Pilbara Plateau in the north and the Darling Plateau in the south. It now appears as a new plateau above the surface of which rise isolated hill and ridges, which are the residuals of earlier cycles of erosion. This new plateau consists of broad, relatively level and featureless valleys between the residuals and has resulted from erosion with restricted vertical corrasion and wide lateral erosion. The elevation of the new plateau generally ranges from 1,000 to 2,000 feet above sea level. Rising abruptly out of the plain are the residuals which appear as low hills or ridges or as quite imposing peaks and short ranges which serve as prominent landmarks. The section at the foot of Figure 1, illustrates the general topography of the country.

The streams draining the valleys have more or less poorly defined courses and the shallow beds are quite inadequate to carry off the water following heavy rains. In consequence, considerable areas of the level valley floors are subject to periodic but temporary inundation, a fact which is postulated as an important factor in the development of the characteristic soil profile.

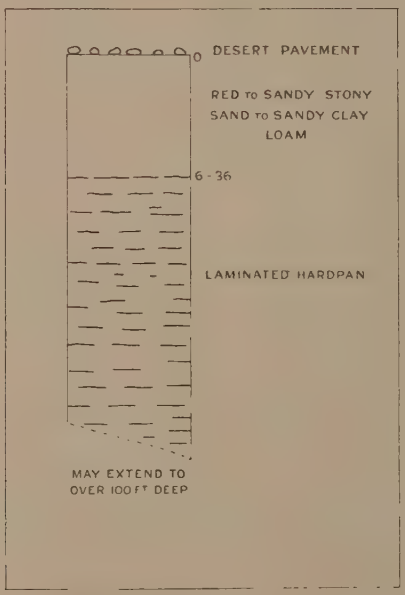


Figure 2.

Diagrammatic representation of a typical profile of the red and brown hardpan soils showing—

(a) the desert pavement,
(b) the undifferentiated surface soil,
(c) the laminated hardpan.

A feature of the eastern portion of the zone which is not drained by coastal rivers, is the salt "lake" system. This is included in the Salinaland of Jutson, (1934). No apparent relation between the salt "lakes" and soil development appears to exist as the lakes appear to be identical in mode of occurrence whether in the hardpan zone, the "mallee" zone or the desert sand hill zone.

*The Soils.*

It is in the broad valleys that the typical soil profiles have developed. The principal features are represented in Figure 2.

Stony surfaced plains are characteristic of the zone, although considerable areas occur in which the surface stones are absent. These stony surfaced plains are known as "serir" or "gibber" plains and the stones are formed largely from the mechanical breakdown of quartz rocks and from quartz-haematite duricrust. Under desertic conditions, the wind removes the fine soil material by deflation and this leaves a so-called "desert pavement." The pebbles usually exhibit the phenomenon of "desert glaze.'

The surface soil itself is generally from one to two feet deep and shows little or no differentiation into horizons above the hardpan. The texture ranges from sand to sandy clay loam and the soil is typically gritty and sharp to the feel. Pebbles of quartz-haematite and other materials are often found throughout the layer but are more prevalent with depth and at a maximum just above the hardpan. Information concerning the reaction and mechanical analysis and replaceable base content of selected samples, representing the surface soil, is reported in Tables 5 and 6.

TABLE 5.

*Mechanical Analyses and Replaceable Bases of Selected Samples of the Red and Brown Hardpan Soils.*

A.—MECHANICAL ANALYSES.

| Serial No. | Depth. | Coarse Sand. | Fine Sand. | Silt. | Clay. | Loss on Acid Treatment. | Moisture. | Loss on Ignition. |
|---|---|---|---|---|---|---|---|---|
| | inches. | % | % | % | % | % | % | % |
| A 1194 ... | 0—9 | 32·8 | 30·1 | 14·8 | 20·6 | 0·4 | 0·7 | 3·7 |
| A 1196* ... | 0—6 | 46·1 | 27·2 | 8·2 | 9·1 | 3·7 | 0·8 | 8·2 |
| A 1203 ... | 0—12 | 30·4 | 49·4 | 3·0 | 15·0 | 0·2 | 0·8 | 3·6 |
| A 1204 ... | 12—20 | 27·4 | 50·6 | 3·8 | 16·3 | 0·3 | 0·9 | 3·8 |
| A 1208 ... | 0—12 | 41·3 | 31·2 | 4·9 | 20·7 | 0·2 | 0·9 | 4·2 |
| A 1209 ... | 12—22 | 40·3 | 33·4 | 7·3 | 15·9 | 0·3 | 1·1 | 4·0 |

B.—REPLACEABLE BASES (AIR-DRIED SOIL BASIS).

| Serial No. | Depth. | pH. | Clay. | Milliequivalents per 100 grams of Air-dried Soil. | | | | Total. | Percentage of Total Bases. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca. | Mg. | K. | Na. | | Ca. | Mg. | K. | Na. |
| | inches. | % | % | % | % | % | % | % | % | % | % | % |
| A1194 ... | 0—9 | 6·79 | 20·6 | 1·50 | 1·74 | 0·68 | 0·44 | 4·36 | 34 | 40 | 16 | 10 |
| A1196* ... | 0—6 | 7·52 | 9·1 | 11·04 | 7·73 | 0·86 | 1·38 | 21·01 | 52 | 37 | 4 | 7 |
| A1203 ... | 0—12 | 6·26 | 15·0 | 1·58 | 0·70 | 0·47 | 0·13 | 2·88 | 55 | 24 | 16 | 5 |
| A1204 ... | 12—20 | 6·46 | 16·3 | 2·04 | 0·78 | 0·53 | 0·16 | 3·51 | 58 | 22 | 15 | 5 |
| A1208 ... | 0—12 | 5·00 | 20·7 | 1·08 | 0·78 | 0·18 | 0·40 | 2·44 | 44 | 32 | 7 | 17 |
| A1209 ... | 12—22 | 5·39 | 15·9 | 1·83 | 1·80 | 0·38 | 0·83 | 4·84 | 38 | 37 | 8 | 17 |

* This soil showed peculiar properties with respect to dispersion. The loss on ignition and the total replaceable bases resembled soils with four times the clay content.

Analyst: B. L. SOUTHERN,
Government Chemical Laboratory.

These data support the field observations that the surface soil (above the hardpan) shows little or no segregation of materials or any systematic change in reaction with depth.

TABLE 6.

*The reaction of Samples of Soil Material above the Hardpan in the Red and Brown Hardpan Soil Zone.*

(Samples treated do not include intrazonal types.)

| | pH Value. | | | | | Total |
|---|---|---|---|---|---|---|
| | Below 5 | 5 to 6 | 6 to 7 | 7 to 8 | Above 8 | |
| Number of samples ... | 7 | 13 | 7 | 9 | 2 | 38 |

The reaction typically ranges from strongly acid to neutral, although examples of alkaline soils are obtained, generally from localised patches. Even for soils of similar appearance the range of reaction is quite wide. For instance, two sites very similar in general appearance, were sampled west of Wiluna.

| Serial No. | Depth. | Description. | Clay. | pH. |
|---|---|---|---|---|
| | inches. | *Site* 1.—9 *Miles West of Wiluna.* | % | |
| A 1203 ... | 1—12 | Brownish red loamy sand ... ... ... | 15·0 | 6·26 |
| A 1204 ... | 12–20 | Brownish red sandy loam resting on hardpan | 16·3 | 6·46 |
| | | *Site* 2.—26 *Miles West of Wiluna.* | | |
| A 1205 ... | 0—7 | Brownish red sandy loam ... ... ... | ... | 5·11 |
| A 1206 ... | 7—12 | Brownish red gravelly sandy loam resting on hardpan | ... | 4·86 |

The explanation of the acidity of these soils of such low rainfall conditions is rather obscure, but it is suggested that the periodic floods bring about a soil climate which is highly humid for a period and thus is responsible for the formation of leached soils. It is possible that lateral movement of water in the profile in the process of leaching is important, as there is little or no evidence of clay accumulation with depth in many instances. On the other hand, it may be suggested that the climatic conditions do not favour chemical weathering and the accumulation of clay minerals in the subsoil. Under the prevailing conditions the clay minerals are stable and surface reactions, reflected in the replaceable bases and reaction, are dominant.

Another possible factor is the mineral material from which the soil is forming. It is possible that much of the soil-forming material has itself been highly leached in a previous climatic cycle and this is reflected in the reaction of the present soils. The occurrence of the alkaline forest soils of the valleys of the "mallee" zones does not support this thesis, but leads to the conclusion that the climatic factor is of prime importance.

Additional evidence of the high degree of leaching exhibited by the hardpan soils is afforded by the extremely high specific resistance of the soil water suspension. Measurement of the specific resistance of the 1 to 5 soil water suspension shows this to range from 10,000 ohms to 45,000 ohms. These figures are characteristic of soils of more humid regions and of such other soils as the sandplain soils of the wheat belt, but not of forest soils of similar texture under low rainfall conditions. In the wheat belt, the 1:5 aqueous suspensions of normal forest soils of sandy loam to sandy clay loam texture generally show specific resistances ranging from 1,000 ohms to 5,000 ohms.

Although only six samples were examined for replaceable bases it is considered that they represent the hardpan soils of the zone. The analyses show that in general the soils are extremely low in replaceable bases. When brought to the basis of 100 per cent. clay the total bases of the samples analysed would be as follow:—

No. 1194 21.2 m. eq.; No. 1196 230 m. eq.;
No. 1203 19.2 m. eq.; No. 1204 21.5 m. eq.;
No. 1208 11.8 m. eq.; No. 1209 30.2 m. eq.;

The figure for No. 1196 is abnormally high, and the rest are low in replaceable base content.

In order to obtain data on the possible cause of these anomalies, Dr. Dorothy Carroll of the Geology Department of the University of Western Australia has examined the samples for the presence of clay minerals. The samples were first boiled in 1 : 1 hydrochloric acid to remove iron. The material was then washed to remove clay by decantation, and the coarse sand fraction separated by means of a 70 mesh I.M.M. sieve. The remaining fraction, principally fine sand, was examined microscopically, and was found to contain two classes of clay minerals—

(a) Nontronite group: rounded, "felty" grains, often practically opaque, but may be feebly polarising at the edges. They are often of radial structure. Refractive index up to 1.63.

(b) Beidellite group: angular grains, semi to completely opaque; usually more ferruginous than (a), and with "felty" surfaces. Refractive index about 1.53.

Samples No. 1194, 1203, 1204, 1208, and 1209 were rather similar, and showed the predominance of the nontronite group of clay minerals.

Sample No. 1196 showed abundant nontronite minerals, and also large amounts of an angular clay mineral, probably of the beidellite group. It is estimated that the fraction examined from sample No. 1196 contained three times as much clay mineral as did the other samples. As the beidellite group is reactive with respect to base exchange phenomena this observation will account, at least in part, for the anomalous results obtained in the examination of the replaceable bases of sample No. 1196. The abundance of clay minerals of the nontronite group correlates with the low content of replaceable bases of the other samples.

It is of interest to note that sample No. 1196 was taken on Dairy Creek Station in carboniferous country, while the others were from areas mapped geologically as granitic.

The composition of the replaceable bases shows the soils to be of the calcium-magnesium group and in this respect resemble the soils of the "mallee" zone. Sodium is relatively high in two samples. However, in spite of the high proportions of magnesium and sodium there is no sign of any structure typical of solonised soils. The content of replaceable potassium is regarded as good, particularly in view of the low total replaceable base figures.

Below the surface layer is encountered the hardpan which cannot be penetrated by ordinary sampling tools. This layer is laminated and probably allows root penetration, but seriously restricts drainage. No effervescence with dilute hydrochloric acid is evidenced by the surface layers of the cement but the deeper horizons, as exposed in road cuts, may be calcareous. It has been observed that lime accumulation in the hardpan is more general in areas transitional with the "mallee" zone. Under these conditions the calcium carbonate occurs as a coating between the laminae of the siliceous hardpan.

The conditions under which these soils are forming are, first, extreme desiccation during the greater part of the year, and second, waterlogging following the heavy rains which are of infrequent occurrence. The part played by the vegetation is probably not very great under these conditions. The soil climate may thus be described as generally very arid but with definite, if short, periods of high humidity. Following periods of heavy rains the surface soils of the level valley floors become waterlogged and the excess water drains away rather slowly, vertical movement being restricted by the hardpan. Further, the actual river channels are shallow and it takes very little heavy rain to cause the rivers to overflow their banks and spread, often for miles over the surrounding country. The conditions associated with the waterlogging lead to the solution of cementing agents in the soil and these move to but shallow depths; in fact, are restricted to the layer immediately below the A horizon. With the disappearance of the excess water, the cementing agents in solution apparently deposit as a cement, causing the formation of the hardpan. The mode of occurrence of the hardpan suggests that it represents part of a mature soil profile. Apparently the soil has been built up by gradual deposition of material on the surface and the rate of formation of the hardpan has kept pace with the accretion. Thus, the hardpan is very generally 30 or 40 feet thick and in places is over 100 feet thick. At other places it may rest on parent material at a depth of but one or two feet below the surface.

At first sight, it may be thought that the brownish red cement would be of a ferruginous nature, but treatment with concentrated hydrochloric acid shows that the iron readily dissolves from the matrix of the hardpan, leaving a white cemented sand very similar in hardness to the original cement. This test precludes iron oxide and calcium carbonate as cementing agents in this instance. Treatment of the white "sandstone" with concentrated and dilute hydrofluoric acid causes disintegration and solution of the matrix.

It seems most likely, therefore, that the cementing agent is secondary silica. Other examples of siliceous hardpan have been observed in soils liable to flooding in the Gingin area and have been studied by Taylor and England (1929) in the Renmark Irrigation area.

The mobility of silica under tropical conditions is well known. Tropical soils are characteristically rich in sesquioxides and low in silica: waters of tropical rivers, too, have been observed to be richer in soluble silica than waters from the temperate regions.

*Intrazonal and Transitional Soils.*

Some mention is appropriate of a number of important soils of minor occurrence within the zone.

One interesting soil type is a very heavy red clay which may be observed as small patches and as strips. There has been no marked profile development and the reaction is neutral to alkaline. The most extensive occurrence of this type known to the writer appears as a strip which ranges up to about one mile wide and which runs in a shallow valley for at least 100 miles southwards from Paynes-

ville. It is possible that this soil has formed on a basic dyke of considerable magnitude. The present vegetation is principally blue-bush (*Kochia sp.*) and salt-bush (*Atriplex sp.*).

The second type is known throughout the area as "Wandarrie" soil and appears to occur as low rises or sand-filled depressions where the sand or sandy loam horizon is of considerable depth. "Wandarrie" soil is valued for gardening purposes and under irrigation yields good crops of vegetables, citrus, etc., for providing station supplies.

Spinifex (*Triodia spp.* and *Triraphis spp.*) is relatively unimportant in the zone but occurs on the stony hills, where the soil is principally gravel, and on patches of sandy country. It is thought that this sandy country, carrying spinifex, represents outliers of the central desert formations lying further eastwards.

East of the Mt. Magnet neighbourhood salt-bush and blue-bush flats become more common and are a typical feature of the zone. These flats appear to represent old lacustrine formations and are characterised by outcrops of limestone with flints. From the meagre information available it appears that the hardpan, where it occurs on these flats, is softer than in the mulga scrub country.

A fifth group are popularly referred to as "opaline" soils. These are forming on limestone deposits often associated with the draining systems. Some of these soils are grey and powdery and resemble the "morrel" soils of the eastern wheat belt; others are brown soils with calcareous subsoils. Shallow water is frequently obtainable in wells in the "opaline" country.

On the south and south-western boundaries an important area of transitional country fringes the red and brown hardpan soil zone and exhibits features of both this zone and the "mallee" soil zone. It occurs as a discontinuous fringe characterised by a group of sandy soils which carry in the virgin state cypress-pine (*Callitris glauca*) and York-gum (*E. foecunda var. loxophleba*) association. The surface soil is a sand to sandy loam which may be quite deep, or, in other instances, may rest on a hardpan similar in nature to that of the soils associated with the Mulga (*Acacia spp.*) vegetation association. These soils further resemble the red and brown hardpan soils in being generally quite acid in reaction. They have been described in some detail by Simpson and Teakle (1934) as types 1D (the shallow phase) and 1E (the deep phase).

With these soils occur typical representatives of the "mallee" zone such as are associated with salmon gum, gimlet and morrel timbers.

From detailed field observations made at Cleary, which lies just within this transitional zone, it is considered that the hardpan formations are disintegrating rather than extending into the contiguous soil zone. In the Mollerin sand (unpublished data) the hardpan is fragmental and in the Mollerin sandy loam, in which the hardpan is still indurated, infiltration with calcium carbonate in the upper layers is observed.

*The Occurrence of Laterite and Other Duricrust Formations.*

While laterite does not occur as extensively as in the south-western portion of the State, it is a constantly recurring feature. It is observed as a capping on many of the hills and occurs also as patches which appear to be formed of broken and transported material.

The mode of occurrence suggests that the laterite is a residual formation representing prehistoric conditions. Under the present conditions of intermittent saturation with water followed by long periods of desiccation, conditions described as favourable for the formation of laterite, a siliceous hardpan is forming on the broad plains and no evidence of laterite formation has been noticed by the writer or associates.

Another duricrust formation observed as a capping on many hills is quartz-haematite. The very general occurrence of this material as a fragmental gravel in the soils suggests that quartz-haematite duricrust was once far more extensive than at present.

*Occurrence of Ground Water.*

A very general occurrence of ground water of potable and stock water qualities is a feature of the zone and is tapped by shallow wells and by bores, generally less than 200 feet deep. This is in marked contrast with the "mallee" zone, where the typical ground water of the valleys is extremely saline, generally ranging in concentration from one per cent. to five per cent. total water soluble salts.

*Pastoral Development.*

None of the hardpan zone may be properly described as agricultural, but the area constitutes an important section of the pastoral development of the State. The chief pastoral industry is wool production and about 3,000,000 merino sheep are run in the area. Cattle, for beef purposes, are carried on certain holdings. The units of development, known as stations, comprise areas ranging generally from 250,000 acres to a million acres or more. The paddocks are large, generally 20 to 25 square miles in extent, and cultivation, except for garden purposes, is not practised. The stock are allowed a wide range and the stocking capacity generally reckoned at one sheep to 20 or 30 acres. The stock feed on the grass and herbage when available after the rains and make use of the mulga products (leaves, pods and seeds) and miscellaneous edible shrubs as a supplement. The mulga seed appears to be highly nutritious and supplements the lower feed value of the leaves and pods. These products of the mulga tree or scrub form the foundation of the pastoral industry and during the droughty periods, in many cases are practically the sole support of the stock.

Where the blue-bush and salt-bush plains occur to the eastwards of Mount Magnet, these are valued for grazing purposes and appear to stand stocking quite well. They form useful supplements to the mulga scrub country. Spinifex country in the zone is regarded as less valuable than in the north-western coastal areas, but also serves as a supplement to the other types of vegetation in drought periods.

These pastoral areas were developed in the days of horse, camel and donkey transport. Distances and isolation under those conditions were magnified as compared with the present day, when motor transport has revolutionised, not only communications with the outside world, but also the management of the station unit. The climate and physiography render road making for limited motor traffic both simple and inexpensive.

*Summary.*

The occurrence of an extensive belt of hardpan soils in the "Acacia semi-desert scrub" or "mulga" area of Western Australia has led to the definition of a new major soil type for Australia. This soil type is referred to as "red and brown hardpan soils of the Acacia semi-desert scrub."

The soil is forming under low rainfall conditions: the mean annual rainfall is about 10 inches and the atmospheric conditions are generally very dry. The average saturation deficit for the year is 0.40 inches of mercury, which is equivalent to 5.44 inches of water.

The soil profile consists generally of an acidic surface layer, more or less indifferentiated, red to brown in colour and ranging in texture from a gritty sand

to a sandy clay loam. At a depth, generally not more than one to two feet below the surface, a hard siliceous hardpan is encountered. This hardpan occurs in horizontal laminae generally about an inch thick. It appears ferruginous, but digestion in concentrated hydrochloric acid removes the coating of iron and leaves an indurated sandstone residue.

The area is used for pastoral purposes.

Overstocking is causing the elimination of certain stock feeds and in some instances the "mulga" is dying for no apparent reason. The "mulga" and other top feeds are the foundation of the area and must be conserved at all costs to assure the future.

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TABLE 1.

*Mean Monthly Rainfall of Selected Stations within the Red and Brown Hardpan Soil Zone and of Selected Stations outside the Zone for purposes of comparison.*

(Data from C.S.I.R. Pamphlet No. 42, 1933.)

| Station. | Jan. | Feb. | Mar. | Apl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual Average. | No. of years recorded. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A.—Stations Within the Red and Brown Hardpan Soil Zone.** | | | | | | | | | | | | | | |
| | points. | points. | points. | points. | points. | points. | points. | points. | points. | points. | points. | points. | | |
| Laverton... ... | 86 | 102 | 152 | 88 | 108 | 93 | 57 | 58 | 34 | 26 | 68 | 84 | 956 | 31 |
| Lawlers ... ... | 75 | 86 | 110 | 86 | 108 | 97 | 64 | 57 | 25 | 23 | 35 | 57 | 823 | 34 |
| Yalgoo ... ... | 62 | 92 | 107 | 53 | 133 | 186 | 132 | 105 | 51 | 35 | 23 | 38 | 1,017 | 34 |
| Murgoo ... ... | 60 | 66 | 105 | 44 | 121 | 174 | 111 | 77 | 25 | 14 | 18 | 29 | 844 | 42 |
| Cue ... ... | 101 | 77 | 104 | 70 | 110 | 134 | 94 | 73 | 34 | 24 | 25 | 46 | 892 | 36 |
| Peak Hill ... | 129 | 127 | 155 | 98 | 110 | 135 | 63 | 46 | 20 | 16 | 38 | 66 | 1,003 | 33 |
| Mundiwindi ... | 103 | 195 | 201 | 76 | 65 | 87 | 12 | 35 | 25 | 53 | 46 | 121 | 1,019 | 15 |
| **Mean** ... | 92 | 113 | 138 | 78 | 106 | 122 | 70 | 62 | 32 | 30 | 39 | 69 | 952 | ... |
| **B.—Stations Outside the Zone.** | | | | | | | | | | | | | | |
| Carnarvon ... | 40 | 80 | 68 | 62 | 154 | 266 | 170 | 63 | 25 | 12 | 4 | 8 | 952 | 48 |
| Watheroo ... | 41 | 58 | 70 | 71 | 232 | 368 | 326 | 222 | 158 | 87 | 32 | 36 | 1,701 | 32 |
| Kellerberrin ... | 34 | 44 | 102 | 76 | 169 | 226 | 220 | 166 | 117 | 79 | 41 | 63 | 1,337 | 38 |

100 points = 1 inch.

TABLE 2.

*Mean Monthly Temperatures of Selected Stations within the Red and Brown Hardpan Soil Zone, and of Selected Stations outside the Zone for purposes of comparison.*

(Data from C.S.I.R. Pamphlet No. 42, 1933.)

MONTHLY MEANS.

| Station. | Jan. | Feb. | Mar. | Apl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual Mean. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.—STATIONS WITHIN THE RED AND BROWN HARDPAN SOIL ZONE. | | | | | | | | | | | | | |
| | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. | °F. |
| Laverton ... ... | 82·6 | 81·5 | 76·4 | 69·3 | 60·4 | 54·1 | 52·5 | 55·8 | 62·6 | 68·5 | 76·4 | 81·1 | 68·4 |
| Lawlers ... ... | 84·2 | 83·0 | 77·9 | 70·2 | 60·8 | 54·7 | 52·9 | 56·0 | 62·3 | 68·5 | 77·2 | 82·3 | 69·2 |
| Yalgoo ... ... | 83·6 | 82·6 | 78·2 | 71·0 | 61·4 | 55·8 | 53·8 | 55·8 | 61·2 | 66·4 | 74·9 | 80·8 | 68·8 |
| Murgoo ... ... | 85·6 | 84·7 | 80·0 | 72·9 | 62·8 | 56·7 | 54·7 | 56·8 | 62·8 | 68·3 | 76·6 | 82·5 | 70·4 |
| Cue ... ... ... | 86·4 | 85·3 | 80·4 | 72·6 | 62·7 | 56·5 | 54·6 | 57·3 | 63·1 | 68·8 | 77·6 | 83·4 | 70·7 |
| Peak Hill ... ... | 87·0 | 86·0 | 82·2 | 73·9 | 64·0 | 57·4 | 55·8 | 58·9 | 65·6 | 71·8 | 80·0 | 86·0 | 72·4 |
| Mundiwindi ... ... | 87·5 | 85·8 | 81·6 | 73·9 | 64·4 | 57·2 | 55·6 | 59·8 | 67·4 | 73·9 | 82·2 | 85·6 | 72·9 |
| Mean ... ... | 85·3 | 84·1 | 79·5 | 72·0 | 62·4 | 56·1 | 54·3 | 57·2 | 63·6 | 69·5 | 77·8 | 83·1 | 70·4 |
| Standard deviation | 1·85 | 1·78 | 2·12 | 1·83 | 1·54 | 1·24 | 1·27 | 1·59 | 2·14 | 2·54 | 2·46 | 2·04 | 1·75 |
| B. STATIONS OUTSIDE THE ZONE. | | | | | | | | | | | | | |
| Carnarvon ... ... | 79·6 | 80·1 | 79·0 | 74·9 | 68·1 | 63·4 | 61·1 | 62·8 | 66·1 | 68·9 | 73·2 | 76·8 | 71·2 |
| Watheroo ... ... | 76·2 | 76·3 | 72·8 | 66·4 | 58·3 | 53·8 | 51·6 | 52·8 | 56·6 | 59·8 | 68·0 | 73·0 | 63·8 |
| Kellerberrin ... ... | 77·0 | 76·4 | 72·2 | 65·5 | 57·6 | 53·6 | 51·4 | 52·8 | 56·6 | 61·4 | 69·8 | 74·4 | 64·1 |

TABLE 3.

*Compilation showing the Saturation Deficit (s.d.) of Selected Stations within the Red and Brown Hardpan Soil Zone and of Selected Stations outside the Zone.*

The approximate Annual Evaporation in inches of water from a free water surface is given by multiplying the Saturation Deficit by 300 (Prescott, 1934, p. 56).

(Data calculated from information in C.S.I.R. Pamphlet No. 42, 1933.)

SATURATION DEFICIT (s.d.) (inches of mercury.)

| Station. | Jan. | Feb. | Mar. | Apl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Annual. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.—WITHIN THE RED AND BROWN HARDPAN SOIL ZONE. | | | | | | | | | | | | | |
| Laverton ... ... | ·72 | ·65 | ·50 | ·37 | ·24 | ·16 | ·15 | ·21 | ·32 | ·42 | ·59 | ·68 | ·37 |
| Lawlers ... ... | ·75 | ·68 | ·51 | ·37 | ·22 | ·15 | ·15 | ·20 | ·31 | ·42 | ·60 | ·71 | ·37 |
| Yalgoo ... ... | ·69 | ·60 | ·47 | ·33 | ·18 | ·10 | ·09 | ·13 | ·22 | ·32 | ·49 | ·64 | ·30 |
| Cue ... ... ... | ·79 | ·71 | ·58 | ·40 | ·22 | ·14 | ·13 | ·18 | ·29 | ·39 | ·57 | ·72 | ·37 |
| Peak Hill ... ... | ·87 | ·80 | ·71 | ·48 | ·29 | ·19 | ·19 | ·25 | ·39 | ·53 | ·75 | ·86 | ·46 |
| Mundiwindi ... ... | ·96 | ·85 | ·70 | ·55 | ·35 | ·24 | ·25 | ·32 | ·49 | ·66 | ·88 | ·91 | ·55 |
| Mean ... ... | ·80 | ·72 | ·58 | ·42 | ·25 | ·16 | ·16 | ·22 | ·34 | ·46 | ·65 | ·75 | ·40 |
| Standard deviation | ·102 | ·094 | ·105 | ·082 | ·061 | ·048 | ·055 | ·065 | ·093 | ·121 | ·142 | ·107 | ·088 |
| B.—OUTSIDE THE ZONE. | | | | | | | | | | | | | |
| Carnarvon ... ... | ·44 | ·41 | ·42 | ·37 | ·27 | ·19 | ·17 | ·20 | ·27 | ·32 | ·35 | ·40 | ·31 |
| Watheroo ... ... | ·57 | ·53 | ·41 | ·30 | ·15 | ·09 | ·08 | ·11 | ·17 | ·25 | ·40 | ·50 | ·26 |
| Kellerberrin ... ... | ·45 | ·40 | ·30 | ·21 | ·10 | ·07 | ·06 | ·08 | ·14 | ·23 | ·38 | ·44 | ·21 |

TABLE 4.

*Compilation showing the Precipitation : Saturation Deficit Quotient (P : s.d.) for Selected Stations in the Red and Brown Hardpan Soil Zone and for Selected Stations outside the Zone for purposes of comparison.*

(To illustrate the monthly fluctuations of the P : s.d. quotient, the quotients of the monthly precipitations and the saturation deficits have been calculated and multiplied by twelve to place on an annual basis.)
(Data calculated from information in C.S.I.R. Pamphlet No. 42, 1933.)

Precipitation : saturation deficit quotients by months multiplied by twelve.

| Station. | Jan. | Feb. | Mar. | Apl. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | P : s.d. Quotient (Meyer ratio). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A.—Stations within the Red and Brown Hardpan Soil. | | | | | | | | | | | | | |
| Laverton ... ... | 14·3 | 18·8 | 36·5 | 28·5 | 54·0 | 69·7 | 45·6 | 33·1 | 12·7 | 7·4 | 13·8 | 14·8 | 25·8 |
| Lawlers ... ... | 12·0 | 15·2 | 25·9 | 27·9 | 59·0 | 77·6 | 51·2 | 34·2 | 9·7 | 6·6 | 7·0 | 9·6 | 22·2 |
| Yalgoo ... ... | 10·8 | 18·4 | 27·3 | 19·3 | 88·7 | 223·2 | 176·0 | 97·0 | 27·8 | 13·1 | 5·6 | 7·1 | 33·9 |
| Cue ... ... ... | 15·4 | 13·0 | 21·5 | 21·0 | 60·0 | 115·0 | 86·7 | 48·7 | 14·0 | 7·4 | 5·3 | 7·7 | 24·1 |
| Peak Hill ... ... | 17·8 | 19·1 | 26·2 | 24·5 | 45·5 | 85·3 | 39·8 | 22·1 | 6·2 | 3·6 | 6·1 | 9·2 | 21·8 |
| Mundiwindi ... | 12·9 | 27·5 | 34·4 | 16·6 | 22·3 | 43·5 | 5·8 | 13·1 | 6·1 | 9·6 | 6·3 | 16·0 | 18·5 |
| District Means ... | 13·8 | 18·8 | 28·6 | 22·3 | 50·8 | 91·5 | 52·5 | 33·8 | 11·3 | 7·8 | 7·2 | 11·0 | 23·8 |
| B.—Stations Outside the Zone. | | | | | | | | | | | | | |
| Carnarvon ... ... | 10·9 | 23·4 | 19·4 | 20·1 | 68·4 | 168·0 | 120·0 | 37·8 | 11·1 | 4·5 | 1·4 | 2·4 | 30·7 |
| Watheroo ... ... | 8·6 | 13·1 | 20·5 | 28·4 | 185·6 | 490·7 | 489·0 | 242·0 | 111·5 | 41·8 | 9·6 | 8·6 | 65·4 |
| Kellerberrin ... | 9·1 | 13·2 | 40·8 | 43·4 | 202·8 | 387·5 | 440·0 | 249·0 | 100·3 | 41·2 | 13·0 | 17·2 | 63·7 |

## APPENDIX TABLE I.

### INCIDENCE OF BIG RAINS IN THE RED AND BROWN HARDPAN SOIL ZONE.

Figures calculated from data supplied by the Divisional Meteorologist to the basis of number of falls in each range per 100 years.

| Station. | Years Records. | Period of Precipitation. | Number of falls in each precipitation range. | | | | | | | Total. | Average Annual Rainfall | Proportion of Rainfall received in Heavy Falls. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 to 2 inches. | 2 to 3 inches. | 3 to 4 inches. | 4 to 5 inches. | 5 to 6 inches. | 6 to 7 inches. | Over 7 inches. | | | |
| | | | % | % | % | % | % | % | % | % | points. | % |
| Yalgoo ... ... ... | 38 | 1 day ... | 58 | 13 | 8 | ... | ... | ... | ... | 79 | 1,017 | 19·2 |
| | | 4 days ... | 55 | 11 | 21 | ... | ... | ... | ... | 87 | ... | ... |
| Murgoo ... ... | 46 | 1 day ... | 52 | 7 | ... | 2 | ... | 2 | ... | 63 | 844 | 15·7 |
| | | 4 days ... | 42 | 15 | 2 | ... | 2 | 2 | ... | 63 | ... | ... |
| Lawlers ... ... | 39 | 1 day ... | 54 | 8 | 8 | ... | ... | ... | ... | 70 | 823 | 19·6 |
| | | 4 days ... | 33 | 21 | 8 | ... | 3 | 2 | ... | 67 | ... | ... |
| Laverton ... ... | 35 | 1 day ... | 74 | 26 | 3 | ... | ... | ... | ... | 103 | 956 | 24·1 |
| | | 4 days ... | 46 | 31 | 17 | 3 | ... | ... | ... | 97 | ... | ... |
| Cue ... ... ... | 38 | 1 day ... | 66 | 24 | 5 | .. | ... | ... | ... | 95 | 892 | 22·2 |
| | | 4 days ... | 47 | 29 | 11 | 5 | ... | ... | ... | 92 | ... | ... |
| Peak Hill ... ... | 31 | 1 day ... | 65 | 35 | ... | 6 | ... | 3 | ... | 109 | 1,003 | 26·2 |
| | | 4 days ... | 39 | 32 | 16 | 7 | 3 | 3 | ... | 100 | ... | ... |
| Mundiwindi ... ... | 19 | 1 day ... | 90 | 42 | 11 | 5 | ... | ... | ... | 148 | 1,019 | 32·0 |
| | | 4 days ... | 58 | 32 | 10 | 21 | ... | 5 | ... | 126 | ... | ... |
| Carnarvon ... ... | 52 | 1 day ... | 100 | 38 | 6 | 6 | ... | ... | ... | 150 | 952 | 33·2 |
| | | 4 days ... | 60 | 44 | 19 | 10 | 2 | ... | 2 | 137 | ... | ... |
| Kellerberrin ... ... | 39 | 1 day ... | 62 | 10 | 3 | ... | ... | ... | ... | 75 | 1.337 | 9·8 |
| | | 4 days ... | 62 | 18 | ... | 2 | ... | ... | ... | 82 | ... | ... |

* Average rainfalls taken from C.S.I.R. Pamphlet 42. Records of heavy rainfalls obtained from Divisional Meteorologist to 1934 inclusive.

## APPENDIX TABLE II.

### INCIDENCE OF BIG RAINS BY MONTHS IN THE RED AND BROWN HARDPAN SOIL ZONES.

Figures show the chances of falls of an inch or more being recorded in any month, and are calculated to the basis of 100 years.

*Compilation from data supplied by the Divisional Meteorologist.*

| Station. | Years Records. | January. | Feb. | March. | April. | May. | June. | July. | August. | Sept. | October. | Nov. | Dec. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | % | % | % | % | % | % | % | % | % | % | % | % |
| Yalgoo ... ... | 38 | 8 | 5 | 16 | 3 | 16 | 18 | ... | 2 | ... | ... | ... | 3 | 71 |
| Murgoo ... ... | 46 | 9 | 5 | 13 | 5 | 15 | 17 | ... | 4 | ... | ... | 2 | 2 | 72 |
| Lawlers ... ... | 39 | 7 | 7 | 15 | 8 | 3 | ... | ... | ... | ... | 3 | 8 | 5 | 56 |
| Laverton ... ... | 35 | 11 | 11 | 23 | 14 | 6 | ... | ... | 3 | ... | ... | 6 | 6 | 80 |
| Cue ... ... ... | 38 | 13 | 10 | 18 | 8 | 11 | 8 | ... | 5 | ... | ... | ... | 3 | 76 |
| Peak Hill ... | 31 | 16 | 16 | 32 | 3 | 3 | 7 | 3 | ... | ... | ... | 3 | 7 | 90 |
| Mundiwindi ... | 19 | ... | 16 | 47 | 11 | 5 | 5 | ... | ... | ... | 11 | ... | 16 | 111 |
| Carnarvon ... | 52 | 4 | 12 | 17 | 8 | 17 | 25 | 15 | 4 | ... | 2 | ... | 2 | 106 |
| Kellerberrin ... | 39 | 5 | ... | 13 | 10 | 13 | 10 | 21 | 5 | ... | 3 | ... | 2 | 82 |

# WEST AUSTRALIAN F.A.Q. WHEAT.

## ANALYSIS OF 1935-36 SEASON'S SAMPLE.

L. W. Samuel[1] and G. E. Dean[2].

To determine the quality of the 1935-36 f.a.q. wheat sample and for comparison with previous years, a sample obtained from the Chamber of Commerce was analysed and milled on the experimental mill in the Government Chemical Laboratory and subjected to the standard baking test of the American Association of Cereal Chemists at the Department of Agriculture.

The mechanical and chemical analyses of the wheat are shown in Table 1, together with the results for the 1933-34 and 1934-35 seasons' samples.

TABLE 1.

Mechanical and Chemical Analyses of the F.A.Q. Wheat Sample.

| | 1933-34. | 1934-35. | 1935-36. |
|---|---|---|---|
| Moisture, per cent. ... ... ... ... | 11·35 | 9·84 | 11·60 |
| Declared bushel weight, lbs. ... ... ... | 61½ | 62½ | 63½ |
| Weight of 1,000 grains, gms. ... ... ... | 37·57 | 38·77 | 39·13 |
| Impurities, per cent. ... ... ... ... | 0·7 | 0·4 | 0·7 |
| Screenings, per cent. ... ... ... ... | 2·9 | 3·8 | 2·1 |
| Total millable grain, per cent. ... ... | 96·4 | 95·8 | 97·2 |
| Protein (N x 5·83), per cent. * ... ... | 10·38 | 10·06 | 9·68 |
| Ash, per cent.* ... ... ... ... ... | 1·35 | 1·32 | 1·46 |
| Pelshenke time, minutes ... ... ... | 40 | 31 | 38 |

* On a standard moisture basis of 10 per cent.

The declared bushel weight has increased during the three years considered and the millable grain content of the 1935-36 sample is greater than for the previous two seasons. The protein content of the grain has decreased and is lower than it has been for several seasons. The Pelshenke test indicates that the 1935-36 sample is superior to the 1934-35 sample and equal to the 1933-34 sample.

For the experimental milling the wheat was cold-conditioned to 15.5 per cent. moisture and the flour obtained was separated into two portions. In the milling the first flours were bulked until approximately 60 per cent. of flour (calculated on the wheat) was obtained, this flour kept separate and then milling continued until the appearance of the bran and pollard were normal in order to obtain the total yield of flour. The object in separating the first (or patent) flour was to obtain for the baking test a flour more nearly comparable in grade with commercial flour. Only this patent flour was examined chemically and the results are shown in Table 2, which also contains the data for previous years. The data for the 1935-36 sample are not strictly comparable with those of previous years since the previous practice was to analyse the total flour extracted.

1 Cereal Research Officer, Department of Agriculture.

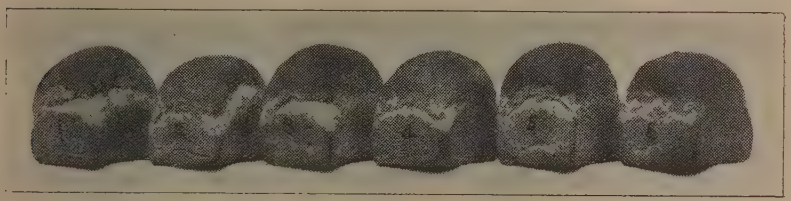
2 Chemist, Government Chemical Laboratory.

TABLE 2.

Milling and Analytical Data for the Flour from the F.A.Q. Wheat Samples.

| | 1933–34. | 1934–35. | 1935–36. |
|---|---|---|---|
| YIELD— | | | |
| Patent flour, per cent. ... ... ... | ... | ... | 63·5 |
| Clear flour, per cent. ... ... ... | ... | ... | 8·9 |
| Total flour, per cent. ... ... ... | 72·9 | 70·9 | 72·4 |
| Pollard, per cent. ... ... ... ... | 8·9 | 11·0 | 8·8 |
| Bran, per cent. ... ... ... ... | 18·2 | 18·1 | 18·8 |
| FLOUR— | | | (Patent) |
| Moisture, per cent. ... ... ... ... | 13·25 | 11·24 | 13·05 |
| Protein (N x 5·7) per cent. ... ... | 9·15 | 9·21 | 8·38 |
| Ash, per cent. ... ... ... | 0·61 | 0·68 | 0·51 |
| Wet gluten, per cent. ... ... ... | 25·89 | 28·90 | 26·39 |
| Dry gluten, per cent. ... ... ... | 8·51 | 9·08 | 8·59 |
| Water absorption, per cent. ... ... | 54·0 | 52·9 | 53·6 |
| Maltose figure (Kent Jones), per cent. ... | 2·09 | 1·89 | 1·76 |

Flour analyses reported on a standard moisture content of 12 per cent.



Loaf 1. Loaf 2. Loaf 3. Loaf 4. Loaf 5. Loaf 6.

Loaf No.

1. Basic formula.
2. Basic formula plus po'assium bromate.
3. Basic formula plus malt extract.
4. Basic formula plus malt extract and bromate.
5. Basic formula plus malt extract and phosphate.
6. Basic formula plus malt extract, phosphate and bromate.

The yield of flour, bran and pollard is normal, but the protein content of the flour is low, due to the low protein content of the wheat and accentuated by the use of a patent flour. Because of the separation of a patent flour, the ash content of the flour is much lower than in previous years and approaches that of a commercial straight-run flour. The water absorption is normal for the experimentally-milled flour from f.a.q. wheat. The maltose figure is within the limits set by Dr. Kent-Jones for satisfactory gas production, and in the baking test the crust colour gave no evidence of lack of diastatic activity in the flour.

The patent flour from the experimental milling was subjected to the experimental baking test of the American Association of Cereal Chemists using hand mixing of the ingredients and the low form of baking tins. The basic formula and five supplementary formulæ were used, and the results are shown in Table 3.

1. The basic formula is—

| | |
|---|---|
| Flour .. .. .. .. | 100 gm. |
| Yeast .. .. .. .. | 3 gm. (3%) |
| Salt .. .. .. .. | 1 gm. (1%) |
| Sugar .. .. .. .. | 2.5 gm. (2.5%) |
| Water .. .. .. .. | Sufficient |

and for the patent flour a water absorption of 53.6 per cent. was used.

The fermentation temperature was 30°C. and the fermentation time was three hours, consisting of 105 minutes to the first punch, 50 minutes to the second punch and 25 minutes to moulding and tinning. The proving period was 55 minutes at 30°C., and the baking time was 25 minutes at 230°C.

TABLE 3.

Results of the Experimental Baking Test.

| Baking Formula. | Volume of loaf in mls. | Loaf No. |
|---|---|---|
| Basic formula .. .. .. .. | 418 | 1 |
| Basic formula plus 0.001% potassium bromate .. .. .. .. | 388 | 2 |
| Basic formula plus 0.5% malt extract .. | 434 | 3 |
| Basic formula plus 0.001% potassium bromate and 0.5% malt extract .. | 401 | 4 |
| Basic formula plus 0.5% malt extract and 0.1% mono-ammonium phosphate | 447 | 5 |
| Basic formula plus 0.5% malt extract and 0.1% mono-ammonium phosphate and 0.001% potassium bromate .. | 412 | 6 |

The negative response to bromate (reduction in loaf volume) is unusual for experimentally milled flours but was quite definite for this flour. The addition of malt and phosphate gave the loaf of greatest volume, though this loaf was not of significantly greater volume than the loaf which received only malt extract. Because of the differences in diastatic activity between commercial and experimental flours milled from the same wheat, it is not possible to state definitely that commercial flours would benefit from the addition of malt extract, but in general, Australian flours are low in diastatic activity and do benefit from the addition of malt flour or malt extract.

## SUMMARY.

The 1935-36 f.a.q. wheat sample is lower in protein content than the previous two seasons, but the Pelshenke test of the wheat and the water absorption of the flour indicate a slight improvement over the 1934-35 sample and equality with the 1933-34 sample.

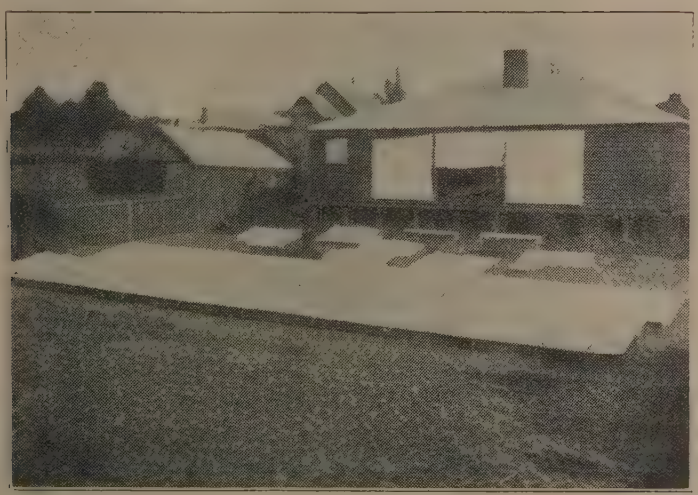
# TOBACCO SEEDBED COVERS.

A. Sharp, Dip Agr.
Tobacco Adviser.

## INTRODUCTORY.

The recent introduction of the use of benzol for the control of downy mildew in tobacco seedbeds has brought into prominence the problem of the most suitable covering material to use on these beds.

Until this season, it has been the usual practice among growers in this State to raise seedlings in open beds. Apart altogether from the question of the control of disease, this practice is open to serious objection. In the first place, to secure seedlings of transplantable size by early October, which is considered the best time to plant out, it is necessary to sow the seedbeds from July onwards. In the Manjimup area, the months of July, August and September are usually cold and wet, resulting in extremely slow growth of seedlings grown in the open. Plants



View of the Experimental Seed-beds at Manjimup.

which have suffered a setback through exposure to these conditions more often than not fail to recover entirely, and give disappointing yields of leaf later on. It has been definitely established that the quickly grown seedling is the one most likely to grow into a plant carrying the maximum weight of leaf. There is also the constant danger that a sharp frost may severely damage, if not entirely destroy, the beds. Open beds, also, afford no protection to the plants against the ravages of insects and slugs.

Owing to the very uncertain results obtainable from these open beds, it has been the usual custom for growers to sow areas far in excess of what might be regarded as normal requirements, the beds being scattered as much as possible away in isolated situations in the bush, in the hope that, although many of the seedlings would probably succumb to the effects of bad weather or disease, suffi-

ent would survive for their owner's requirements. Quite frequently, this hope proved a vain one, and the grower was faced with the necessity of purchasing supplies of seedlings, which, as often as not, were not available when wanted, and, when obtained, might prove to be infected with disease. A frequent result of the consequent irregular planting and mixture of varieties was that at harvest it was almost impossible to pick leaf of even type and maturity, which resulted in uneven curing, and consequent reduction in the price obtained for the finished product.

## THE BENZOL METHOD INVOLVES THE USE OF COVERED SEEDBEDS.

As explained in an article in the September 1936 issue of this Journal, by Mr. H. A. Pittman, Plant Pathologist, and which has been reprinted as Leaflet No. 486, the control of downy mildew (so-called blue mould) by benzol involves the use of closely covered seedbeds, and a fair amount of experimental work has been done in Australia with a view to discovering the most suitable material to use as a cover.

The properties which are desirable in a good seedbed cover from the point of view both of promoting rapid growth of seedlings and of rendering benzol effective in controlling downy mildew are:—

(a) It should be reasonably waterproof.

(b) It should be capable of maintaining an effective degree of concentration of benzol vapour around the plants.

(c) It should be practically colourless, and should allow a maximum of light to reach the plants if the bed should have to be kept closed during bad weather.

(d) It should resist discolouration due to fungal growth.

(e) The cost should not be excessive.

(f) The cover should be highly efficient in conserving warmth at night.

## TYPES OF SEEDBED COVERS.

Glass and glass substitutes have been used with success, but their high initial cost places them out of the reach of the ordinary grower. It may be mentioned, however, that a flexible material known as "Windolite," consisting of transparent cellulose reinforced with fine wire gauze, has given excellent results in the Eastern States. Its price—6s. per square yard—is fairly high, but as it will last for a number of years with careful use it may be worth consideration by growers.

So far, unbleached calico appears to be the most suitable cheap material tried. In the first experiments with benzol, carried out by the Council for Scientific and Industrial Research, calico treated with linseed oil was used as the covering material. This, also, was used on the experimental seedbeds established at Manjimup last year, and, so far as growth of seedlings and control of downy mildew was concerned, was entirely satisfactory. It had, however, the disadvantage that the calico thus treated rotted very rapidly and was subject to a certain amount of discoloration caused by fungal growth on the under side, which tended to render the cover opaque.

The Council for Scientific and Industrial Research has tested a number of substances for treating calico, including tung oil, paraffin wax, beeswax, varnish, and alum and soap preparations, but reports that none of these has been satisfactory.

## EXPERIMENTS WITH VARIOUS KINDS OF SEEDBED COVERS AT MANJIMUP, 1936.

A number of different types of cover have been tried out on the experimental seedbeds at Manjimup this season. These include:—

(a) Untreated calico.

(b) Calico treated with raw linseed oil.

(c) Calico treated with mixtures of paraffin wax, petroleum jelly, and mineral turpentine in varying proportions.

(d) Untreated hessian.

In addition, the results obtained by growers using various types of covers have been observed, both with regard to their effect on the growth of the plants and their effectiveness in the control of downy mildew.

So far as rapidity of growth is concerned, calico treated with linseed oil gave the best results. This material possesses the property of conserving warmth in the seedbed to a quite remarkable degree during cold weather. One small bed, sown on 1st September and covered with this material, yielded seedlings ready for planting out by the third week of October, and the final picking from this bed was made on 3rd November, approximately 800 well grown plants per square yard having been obtained from it by that time. By the end of the season, however, this cover, which had been sticky and unpleasant to handle, had discoloured badly, and was unfit for further use.

### PARAFFIN WAX PREPARATIONS.

Calico covers treated with mixtures of paraffin wax, petroleum jelly and mineral turpentine in varying proportions gave very satisfactory results, except where the proportion of turpentine used was too low.

Early in the season, a mixture in the proportion of 3 lbs. of paraffin wax, 1 lb. of petroleum jelly, and 1 quart of mineral turpentine was tried. It quickly became apparent, however, that this mixture was too thick, with the result that the calico became stiff and board-like, discoloured rapidly, becoming quite black by the end of the season, and the deposition of condensed moisture on the under side at night was heavy. The dropping of this moisture on to the surface of the beds appeared to have a distinctly detrimental effect on the growth of the seedlings. On other covers, the proportion of turpentine was doubled with much more satisfactory results. Two seedbeds, each 45 feet long by 4ft. 6in. wide, were covered with calico treated with the thinner solution. These covers showed a certain amount of discoloration by the end of the season, but not enough to interfere with the health of the seedlings under them. They maintained their flexibility throughout; in fact, it was difficult to tell from their appearance that they had received any treatment at all. They were quite waterproof, and were evidently sufficiently gas tight to render the use of benzol and X3 solvent completely effective in preventing downy mildew. The deposition of moisture on the under side was much reduced, and no damage was done to the seedlings from this cause. The growth under these covers, although not quite so rapid as under oiled covers, was very satisfactory. The seedlings generally took about a week longer to reach the planting-out size than where raw linseed oil was used.

The untreated calico covers proved to be much less satisfactory, the seedlings under them taking at least three weeks longer to reach transplanting size. With regard to disease control, benzol appears to be quite effective under the untreated calico, but there is some evidence that X3 solvent is not 100 per cent. effective.

## HESSIAN COVERS UNSATISFACTORY.

The hessian covers were very unsatisfactory. Growth under them was extremely slow. In one bed, sown on 1st September, which received precisely the same treatment as the others, except for the difference in the cover, only a very small proportion of the plants were large enough to transplant by the middle of November. In another, growth was equally slow until the hessian was replaced by a waxed cover, when the plants almost immediately started into more rapid growth. No downy mildew had appeared under the hessian cover in the experimental beds where benzol was used up to the middle of November, but one or two growers have reported that benzol had failed to entirely eliminate the disease in beds covered with super bags. Apart altogether from disease control, however, hessian may be considered quite satisfactory as a seedbed cover.

On the whole, the paraffin wax mixture has given the most promising results, both on the experimental and on commercial beds.

## A SATISFACTORY PARAFFIN WAX FORMULA.

Fairly late in the season, it was suggested to the writer that a mixture containing 12 parts of paraffin wax to 1 part of petroleum jelly and a little boiled linseed oil, dissolved in mineral turpentine, might give good results. A small quantity was made up and applied to a cheap quality Japanese calico. This, after drying, was fitted over part of a grower's seed bed in which downy mildew had appeared, and benzol placed beneath it at night. The result was remarkable. On examination a fortnight later, that part of the bed not covered was found to have almost completely succumbed to the disease, whilst under the cover, not only had the disease completely disappeared, but the seedlings had made very rapid growth.

From the experience gained this season, therefore, it would appear that excellent results can be obtained by using a fairly cheap unbleached calico, and treating it with the following solution:—

12 lbs. 125°/130° Paraffin Wax.
1 lb. Clear Petroleum Jelly.
1 pint Boiled Linseed Oil.
2 gallons Mineral Turpentine.

## PREPARATION OF THE WATERPROOFING SOLUTION.

The method of making up the solution and applying to the calico is as follows:—

The paraffin wax, which is sold in slabs, should be broken up into small pieces and placed in a suitable metal container, along with the petroleum jelly, and heated gently over a small fire until it has melted. Care should be taken not to overheat. When melted, add the linseed oil and mineral turpentine slowly while stirring the mixture. The calico should then be drawn slowly through the hot mixture so as to completely saturate it, then pulled through the hands to remove surplus mixture, and hung up to dry. Where small covers are being dealt with, half the above quantity made up in a 4-gallon kerosene tin, preferably cut lengthwise, can be used. Where, however, covers exceeding, say, 20 feet by 3 feet are to be dealt with, it will be necessary to use a larger container. A shallow trough made of galvanised sheet iron, with a capacity of about 8 gallons, is recommended. The mixture must be kept hot while dipping the calico, as it sets solid on cooling. If overheated, however, it is liable to catch fire, and it is advisable to have a wet bag handy to smother the flames should this occur. In practice, the process is not so difficult as might be thought, and is much preferable to applying the mixture with a brush. The amount of mixture required will probably vary according to the quality of calico

used, but, with a fairly good quality calico the above amount will be sufficient for about 60 square yards.

It was found that calico so treated tended to shrink, and an allowance of about one yard in thirty should be made if it is cut to size before dipping. A newly dipped cover should not be placed over growing seedlings until it is thoroughly dry, as the fumes of the evaporating turpentine are fatal to the plants.

The cost of treating calico with this mixture works out at about 2½d. per square yard for material at the prices ruling at Manjimup for small quantities.

### FAILURE OF WOODEN COVERS.

Solid wooden covers were tried out by one grower at Manjimup this season, the aim being to keep the beds warm at night. These have not been successful. The bed became infected with downy mildew, and, for some reason which is not fully understood, benzol was entirely ineffective under these wooden covers in controlling the disease. It is considered possible that benzol may be effective only when mixed with a fairly large proportion of air, and that these covers, which were well constructed of tongued and grooved timber, and painted, excluded air too effectively.

### METHODS OF FIXING CALICO COVERS TO THE SEED BEDS.

Various methods of attaching calico covers to the beds have been employed by growers. Probably the most satisfactory method is to construct removable wooden sashes to fit the beds, and to tack the calico to these. The beds can be opened and closed quickly where these are used, and the calico resists discoloration fairly well, as it is never rolled up while wet.

Another method is to simply stretch the calico over wooden bearers and tie it down to the framework of the bed with tapes. To uncover the bed, the tapes are untied and the calico rolled up. This process occupies more time, and as the calico is usually wet in the early morning when the beds are opened, it remains wet all day and discoloration takes place fairly rapidly.

Whichever method is used, it is necessary to give the cover a slope of at least one in six in order to shed rainwater, and a somewhat steeper slope, say one in four, would be better still. It is also necessary to see that the calico is stretched sufficiently tightly to prevent sagging, as the collection of rainwater causes very rapid discoloration with consequent damage to the plants underneath.

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## "DAIRY CATTLE IMPROVEMENT ACT, 1922," AND AMENDMENT ACT, 1932.

### REGISTRATION OF BULLS.

The attention of owners is drawn to the fact that the registration of all grade bulls is due as from the 1st January, and should be effected not later than the 21st of that month. All pure-bred bulls for which life certificates have not been obtained should also be registered by that date or on their attaining the age of nine months.

Under the Regulations it is also obligatory on owners to notify the Department in writing of the transfer, death or desexing of all registered animals.

It is hoped that owners will hasten to comply with the regulations, and so avoid proceedings which it may be necessary to take in order to enforce registration.

# THE TANGIER PEA.

G. K. Baron-Hay,
Superintendent of Dairying.

*Introduction.*

The Tangier Pea (*Lathyrus tingitanus L.*) is an annual indigenous to Northern Africa, but has been grown as an ornamental plant in Europe for many years.

It was first recommended and grown as a fodder by Dr. Trabut, of Algeria, where it is used as winter forage. It is cultivated also in the Canary Islands and Morocco.

Although first introduced to the United States in 1900,[1] it was not till some 20 years later that its great value as a fodder and green manure crop was recognised, and C. V. Piper, United States Department of Agriculture, reports in 1922[2]:—"It has given the largest yields of green matter to the acre of any annual legume grown in California. The dense growth chokes out weeds completely. It is a good green manure crop, but the seed has been hard to get. There is hope that this difficulty may be overcome."

The Tangier Pea is also cultivated as a fodder plant in the south of France, where it is said to be very hardy and able to withstand a temperature as low as 26 degrees Fahrenheit. In this connection, P. de Sorney[3] reports:—"It is a first class fodder plant and thrives very well. It is sown at the beginning of the rains, and its stems rapidly cover the soil. Cattle eat it readily. Attempts should be made to acclimatise this legume in various sub-tropical countries."

Mr. W. E. Barker,[4] Sequin, Washington, writes in 1923:—"I grew the Tangier Pea on the poorest pieces of land on the farm—land that had been cropped to wheat for fifty years. It grew about 7 feet high and made an impenetrable jungle."

On reading these eulogistic reports during 1925, it was thought possible that the Tangier Pea would fill a useful place in the agriculture of this State, and a small packet of seed (2 ounces) was secured through the courtesy of Professor P. B. Kennedy of the Agricultural Experimental Station, California. These seeds were distributed amongst the State Research Farms at Nabawa, Merredin, Wongan Hills, and Denmark, and also Mr. A. T. O'Connell, Dwarda.

A careful perusal of the results obtained from a large number of trials during the years 1926-29 showed that where cultural conditions had been reasonable, good results were obtained. It was noticed, however, that in almost every instance some of the plants failed, but all failures showed similar characteristics. These features were very stunted growth, failure to stool, and a pink to reddish colour of the leaves and stems. It was common to see plants only 9 inches high when six months old, while other plants in the same field and planted on the same day were 7 to 8 feet high.

The Tangier Pea, in common with other legumes, cannot thrive without the assistance of nitrogenous fertilisers, unless certain soil bacteria are found in

1. Ball, C. R.: Grasses and Fodder Plants on the Potomac Flats, U.S. Dept. Agriculture, 1900.
2. Piper, C. V., and Pieters, A. J.: Green Manuring, U.S. Dept. Agriculture, Bulletin 1250, 1922.
3. P. deSornay: Green Manures and Manuring in the Tropics, 1916.
4. P. B. Kennedy: The Tangier Pea. Univ. of California. Circular 290, 1925.

association with it, and growing in colonies or nodules on its root. Those growing on the healthy Tangier Pea are very large and numerous.

The condition described above is that expected where the crop is suffering from the lack of these bacteria. This is verified by the fact that, where farmyard manure or nitrogenous fertilisers were applied in the trials, good growths were obtained.

The bacteria affecting the roots of various species of legumes may be divided into groups, and bacteria from one group are not interchangeable with those in another. Eleven groups have thus been isolated, the bacteria affecting the roots of the Tangier Pea being also common to the Garden Pea and Field Pea (Pisum sativum), Hairy Vetch (Vicia villosa), Broad Bean (Vicia faba), Lentil (Ervum lens), and the Sweet Pea (Lathyrus odoratus). These plants are not yet commonly grown on farms, especially in the South-West Dairy Belt, and quite probably the absence of these bacteria has been a limiting factor for growth.

Tangier Peas.

Demonstration showing effects of want of inoculation. Ladies standing on the uninoculated patch. Hat can be seen on gentleman standing in peas to the left of photo. (Photo. taken 29/11/29.)

Supplies of the necessary nitrogen-fixing bacteria for inoculating the Tangier Pea can be obtained on application from the Department of Agriculture, Perth, at a small cost made to cover packing and postage. Full particulars can be obtained in Leaflet No. 323, which is issued free.

*Description.*

The Tangier Pea (*Lathyrus tingitanus*) is an annual leguminous plant which in general appearance and growth resembles the ornamental Sweet Pea.

The plant shows slow growth during the winter months, but as warm weather approaches the growth is very rapid and strong, and during September the plant quickly attains a height of from 3 to 7 feet, in a tangled mass, producing a dense covering which chokes out all but the strongest weeds.

The Tangier Pea is drought resistant to a high degree, owing to its deep-rooting habit, the roots also having numerous large nodules.

The plant is smooth, with coarse flattened stems and prominent stipules. The leaves consist of a pair of large lanceolate leaflets, the midrib of the leaf terminating in a much branched tendril by which the plant supports itself.

Showing deep rooting habit, with numerous nodules.

The flowers resemble Sweet Pea blossoms, but are small and scarlet in colour. The clusters bear generally two, sometimes three, blooms.

Seeds of Tangier Pea. Enlarged and natural size.

The pods are about 3 inches long, containing 5-8 seeds which are brown, elliptical, flattened, and about ¼ inch long.

*Method of Planting.*

To obtain a heavy crop during the first season, it is recommended that up to 25 lb. of seed per acre be planted with at least 1 cwt. of superphosphate. Good results can be obtained by planting 8 to 10 lb. of seed per acre with superphosphate. For hay and silage crops, Tangier Peas can be grown in association with Oats, the rate of seeding being 5 to 8 lb. of Tangier Peas with 1 bushel of Oats, and an application of 1 to 1½ cwts. of superphosphate.

*As a Forage Plant.*

As some guide to the feeding value of the Tangier Pea, samples of the plant were submitted to the Government Analyst (Dr. E. S. Simpson) for analysis.

The following table shows the Tangier Pea compared with White Dutch Clover and the Common Vetch:—

| | Water. | Ash. | Crude Protein. | Carbohydrates. | | Fat. |
|---|---|---|---|---|---|---|
| | | | | Fibre. | Nitrogen. Free Extract. | |
| White Dutch Clover ... ... ... | 8·1 | 8·0 | 16·2 | 23·2 | 41·6 | 2·9 |
| Vetches (common) ... ... | 7·1 | 8·2 | 17·3 | 26·2 | 38·7 | 2·8 |
| Tangier Pea ... ... ... | 6·36 | 6·12 | 17·94 | 25·12 | 40·62 | 3·84 |

It will be seen that the Tangier Pea closely approximates to the values of these two legumes, as revealed by chemical analysis.

Mr. O'Connell reports that the Pea is relished by all stock, which smashed a fence against which the plants were growing in order to reach them.

The leafage and stalks are eaten by stock, and, in Algeria and California, where considerable quantities have been fed to stock, no deleterious effects have been recorded.

TANGIER PEA STRAW.

| | Moisture. | Ash. | Crude Protein. | Carbohydrates. | | Fat. |
|---|---|---|---|---|---|---|
| | | | | Fibre. | Nitrogen. Free Extract. | |
| 1.—Bean Straw ... ... ... | 11·07 | 6·97 | 5·68 | 41·10 | 33·63 | 1·52 |
| 2.—Oaten Hay ... ... ... | 8·6 | 4·7 | 3·80 | 31·0 | 49·2 | 2·6 |
| 3.—Oaten Straw (Stubble) ... | 11·5 | 5·4 | 3·60 | 36·3 | 40·8 | 2·4 |
| 4.—Tangier Pea Straw ... | 10·00 | 10·64 | 6·42 | 37·10 | 34·06 | 1·78 |

1. Hendry, G. E.: Bean Culture in California. Bulletin 294. California Agricultural Experiment Station.
2. West Australian figures
3. Henry and Morrison: Feeds and Feeding.
4. P. B. Kennedy: The Tangier Pea. Circular 209. University of California.

*Value of Straw.*

Mr. O'Connell has found that all stock—sheep, horses, and cattle—eat the Pea straw with relish, cattle in particular being very keen on it.

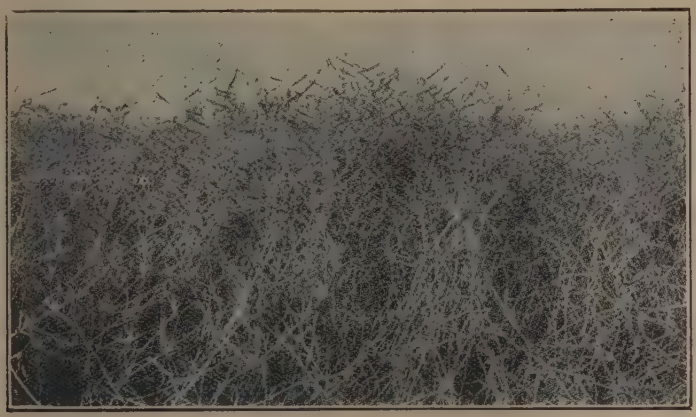
While it is not advisable that the straw should be considered suitable as a feed for stock, by itself, there is no doubt that the straw, when chaffed, would make a valuable bulk feed, especially for cattle.

The above comparisons of Tangier Pea straw with Bean straw, Oaten hay (local), and Oaten stubble indicates that the Tangier Pea straw has a decided feeding value and compares more than favourably with Oaten stubble.

Field Trial with Tangier Pea, 1927. Mr. J. T. O'Connell's Farm, Dwarda. Photo. taken 29th November.

Field Trial, Dwarda, 1927. Note dense tangled growth which choked out all weeds.

For feeding to cattle it is advisable to chaff the straw and moisten it some hours before feeding.



A crop ready to harvest. The straw is fine and relished by stock.

*Summary.*

1. The Tangier Pea shows great promise as a fodder plant and for green manuring in districts with 16 inches winter rainfall or over.
2. Early autumn planting, in April or early May, is recommended.

As the plant grows but little during the cold winter months, this early planting is important.

3. The plant requires 6-7 months to reach maturity.
4. Grown with oats, it gives promise of being an excellent crop for hay and silage.
5. Inoculation of seed is essential for success.

## GRASSHOPPER WARNING.

L. J. Newman, F.R.E.S.,
Government Entomologist.

During the past spring and early summer we witnessed in our Eastern and North-Eastern Wheat Belt the greatest swarm of grasshoppers ever experienced in our wheat areas.

Free bait was supplied by the Government, but in spite of this the fact has to be faced that vast numbers of grasshoppers reached maturity, and have laid millions of eggs. It is presumed that farmers know where the eggs have been laid, whether on their own properties or abandoned land. It must be recognised that all the grasshoppers do not emanate from abandoned properties, many hatching out on private lands that have not been worked for several years. Road sides and other such areas are also fruitful breeding grounds.

To get at the root of this trouble, some method must be adopted whereby abandoned farms and other lands are brought again under cultivation. If this is not done we shall be subject to varying swarms of this pest every year, should

the meteorological and other factors be favourable to the eggs hatching. It would be unwise to sit back and rely on seasonal control, as it is impossible to forecast what the coming season will be.

It is advised, therefore, that all known egg-infested lands be broken up at the first opportunity. The earlier this is done the more effective it will be in the destruction of the eggs. It is not sufficient simply to plough the land, but it must be broken down so that there will be no lumps. If left in a lumpy condition numerous egg pods will be undisturbed in the lumps, and will eventually hatch. Land that is too hard to plough until sufficient rain falls should be worked as soon as sufficiently soft.

The object in working the egg-infested areas is to expose the eggs to the hot sun, birds and predatory insects. Further, land that is broken up and kept worked is unsuitable for egg-laying the following spring. The breaking-up of the egg-infested areas is the most effective, artificial measure of control.

## ROYAL AND DISTRICT AGRICULTURAL SOCIETIES' 50-ACRE CROP COMPETITIONS, 1936.

I. Thomas,
Superintendent of Wheat Farms.

Entry for these competitions is made through the local Agricultural Societies. These societies organise their own district competitions, the first and second prize winners of which automatically become eligible to compete for the Royal Agricultural Society zone prize. Where the local society does not conduct a competition, entry is accepted direct with the parent body, the Royal Agricultural Society. In this way no farmer, desirous of doing so, is prevented from participating.

As can be readily understood, there is considerable variation in rainfall, soil, etc., in a wheat belt so widely extended. For these reasons it has been subdivided into eight zones in such a manner that districts having similar interests and climatic conditions have been grouped together. In this way farmers may compete with each other more equitably. The accompanying map shows the eight zones referred to.

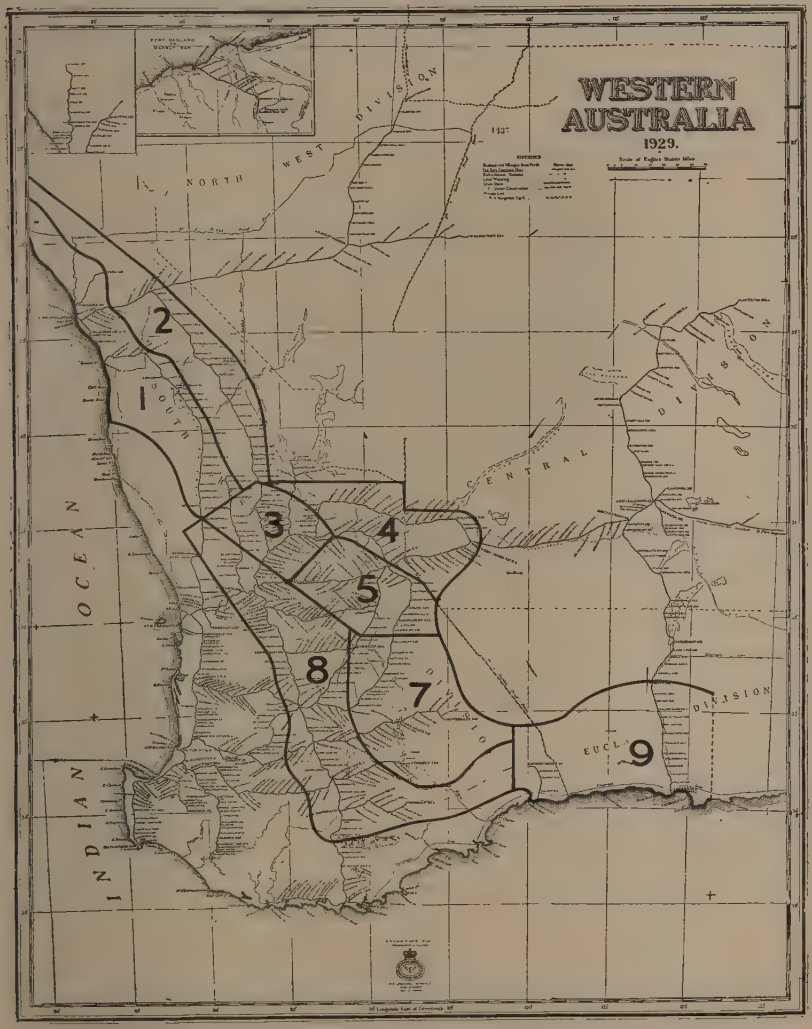
In each of these zones a championship prize of £10 and a second prize of £2 10s. are awarded.

In addition to these zone prizes the Royal Agricultural Society each year offers a special prize of £5 5s. to the competitor in any zone obtaining the highest calculated bushel yield per acre.

The conditions of the competitions require that the crop shall be grown on fallowed land, shall not be less than 50 acres in area of one variety, and shall be judged under the following scale of points:—

| | |
|---|---|
| Yield .. .. .. .. .. .. | 50 points. |
| Freedom from weeds .. .. .. .. | 10 „ |
| Freedom from disease .. .. .. .. | 10 „ |
| Freedom from admixture .. .. .. | 15 „ |
| Evenness of growth .. .. .. .. | 15 „ |
| Total .. .. .. .. .. | 100 points. |

The system adopted has been to allot one point for each calculated bushel yield, which is determined not by estimation but upon that calculated from portions of the crop obtained from small areas taken systematically throughout the crop. These samples are then threshed and the grain weighed.




Map showing boundaries of the respective zones.

Since the inception of the Royal and District Crop Competitions the judges have been Departmental Officers attached to the Wheat Branch of the Department of Agriculture.

The past season has again been an unfavourable one, particularly in the northern, eastern and north-eastern districts. At the end of August crops everywhere were somewhat backward, but looked very healthy and, although it

was realised that there was little reserve moisture in the soils, it appeared that with moderately good finishing rains an average harvest would eventuate. Unfortunately, the period from the 26th August to the end of September was one of the driest for that period of the year ever recorded in the wheatbelt, and was responsible for the estimated yield being reduced by ten million bushels.

The dry spring of 1935 was succeeded by a dry summer and autumn, except in the upper Midlands and portions of the southern agricultural districts, which benefited by moderate to heavy rains early in April.

The May rainfall was below the average throughout the wheatbelt, the deficiency being most pronounced in the eastern and north-eastern districts, where there was insufficient rain to cause a general germination of early sown crops and weed seeds. Seeding operations were considerably delayed and feed reserves were either very low or non-existent. Over the southern and south-eastern wheat belt, conditions were satisfactory as sufficient rain was received to germinate crops and feed.

In the northern areas the position was fair, a good rain being badly needed by the end of the month.

Early in June the rather gloomy seasonal outlook was greatly altered following heavy rains in almost every portion of the wheatbelt. Falls ranged from one to three inches. In many centres it was the best fall which had been experienced for over two years. Water supplies were replenished and a good germination of crops and feed was assured. On the other hand, in some of the Great Southern districts falls were so heavy that seeding operations were seriously retarded. For the remainder of the month falls were only just sufficient to meet the requirements of the crops.

July was a month of under-average rainfall at practically all centres but the falls, though light, were frequent and the crops did not suffer any serious check.

Similar weather was experienced for the first three weeks of August. Good general rains at the beginning of the fourth greatly improved the outlook, though they were not heavy enough to build up much reserve of moisture in the soil.

The subsequent five weeks of warm, dry weather was disastrous for many crops, the northern, eastern and north-eastern districts experiencing the worst season since 1914. A severe frost on the 14th September did considerable damage, while locusts also made their appearance in large numbers in the drier areas. On the 30th September falls ranging from 30 points to over an inch saved the situation from becoming even worse.

In view of the season it is not surprising that there has been a reduction in the number of entries from the northern and eastern districts and the yields obtained by those farmers who have entered crops can be regarded as very creditable.

The detailed awards made by the Judges in the different zones are as follow:—

## ZONE 1.

Judge: G. L. Throssell, Agricultural Adviser.

Competitors: Three Springs, 3; Royal, 1.

The rainfalls recorded at Three Springs and Coorow for the year are as follow:—

| Station. | Jan. | Feb. | Mar. | Apl. | Growing Period. May. | June. | July. | Aug. | Sept. | Oct. | Total. | Nov. | Dec. | Total for Year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Three Springs... | 1 | 24 | 45 | 58 | 122 | 207 | 135 | 184 | 110 | 76 | 834 | 35 | ... | ... |
| Coorow ... | 1 | ... | 71 | 26 | 184 | 271 | 142 | 202 | 73 | 50 | 922 | 36 | ... | ... |

The following tables show the awards made in the Three Springs Society's competition. Details are also given of the entry received direct with the Royal Agricultural Society.

THREE SPRINGS AGRICULTURAL SOCIETY.

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| Lynch, Sen. P. J. | Three Springs... | Bencubbin ... | 24 | 9 | 9 | 13 | 12 | 67 |
| Hebiton, J. K. (Jnr.) | do. ... | Merredin ... | 21 | 9 | 8 | 14 | 12 | 64 |
| Williamson, A. M. | Wanneranooka | Nabawa ... | 20 | 8 | 9 | 12 | 12 | 61 |

ROYAL AGRICULTURAL SOCIETY.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Rudduck, A. ... | Coorow ... | Merredin ... | 18 | 9 | 9 | 14 | 12 | 62 |

## ZONE 2.

Judge: I. Thomas, Superintendent of Wheat Farming.

Royal Agricultural Society—2 entries.

The rainfalls recorded at Damboring for the year are as follow:—

| Station. | Jan. | Feb. | Mar. | Apl. | Growing Period. May. | June. | July. | Aug. | Sept. | Oct. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Damboring ... | No Records | | | 14 | 82 | 312 | 88 | 115 | 51 | 20 | 668 |

The awards made in this competition are given in the following table:—

| Competitor. | Address. | Society. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth | Total. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| S.C. Harrington | Damboring | Royal ... | Gluclub ... | 17 | 7 | 8 | 13 | 12 | 57 |
| R. Bradford ... | Damboring | Royal ... | Gluyas Early | 15 | 8 | 7 | 12 | 12 | 54 |

## ZONE 3.

Judge: F. L. Shier, Senior Agricultural Adviser.

Royal Agricultural Society—2 entries.

The rainfalls recorded at Goomalling for the year are as follow:—

| Station. | Jan. | Feb. | Mar. | Apl. | Growing Period. May. | June. | July. | Aug. | Sept. | Oct. | Total. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Goomalling ... | 12 | 4 | 60 | 21 | 167 | 209 | 140 | 260 | 76 | 32 | 884 | 36 |

The awards made in the competition are given in the following table:—

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| F. B. Johnson & Sons | Goomalling ... | Bencubbin ... | 24 | 9 | 9 | 13 | 13 | 68 |
| T. R. Smith & Sons | do. ... | do. ... | 22 | 9 | 9 | 14 | 13 | 67 |

## ZONE 4.

Judge: W. M. Nunn, Agricultural Adviser.

Mukinbudin-Lake Brown Agricultural Society—6 entries; Nungarin-Eastern Districts Agricultural Society—4 entries; Royal Agricultural Society—1 entry.

The rainfalls recorded for the year at Mukinbudin, Karloning, Nungarin and Bencubbin are given in the following table:—

| Station. | Jan. | Feb. | Mar. | Apl. | Growing Period. May. | June. | July. | Aug. | Sept. | Oct. | Total. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mukinbudin ... | 36 | 4 | 178 | 10 | 57 | 185 | 109 | 131 | 37 | 71 | 590 | 71 |
| Karloning ... | No Record | | 77 | 13 | 67 | 150 | 95 | 164 | 104 | ... | 580 | No Record. |
| Nungarin ... | 99 | 1 | 88 | 8 | 87 | 288 | 105 | 146 | 80 | 13 | 709 | 37 |
| Bencubbin ... | 35 | ... | 62 | 7 | 69 | 278 | 99 | 142 | 34 | 32 | 654 | 34 |

The results of awards in the various competitions are as follow:—

MUKINBUDIN-LAKE BROWN AGRICULTURAL SOCIETY.

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| E. T. & J. G. White | Mukinbudin ... | Bencubbin ... | 16 | 8 | 9 | 12 | 13 | 58 |
| A. J. Clamp ... | do. ... | Totadgin ... | 18 | 7 | 8 | 12 | 12 | 57 |
| — Shadbolt ... | do. ... | Bencubbin ... | 16 | 8 | 8 | 13 | 11 | 56 |
| H. W. Seaby ... | Karloning ... | Totadgin ... | 15 | 7 | 8 | 12 | 12 | 54 |
| H. J. Shadbolt ... | Mukinbudin ... | Gluclub ... | 17 | 8 | 7 | 9 | 12 | 53 |
| Bent & Starr ... | Karloning ... | Totadgin ... | 12 | 6 | 8 | 12 | 9 | 47 |

NUNGARIN AND EASTERN DISTRICTS AGRICULTURAL SOCIETY.

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| Creagh Bros. ... | Nungarin ... | Noongaar ... | 23 | 9 | 9 | 14 | 14 | 69 |
| Watson Bros. ... | do. ... | Bencubbin ... | 22 | 8 | 9 | 14 | 14 | 67 |
| R. C. Fitzpatrick | do. ... | do. ... | 15 | 8 | 9 | 14 | 13 | 59 |
| Roper Bros. ... | Nukarni ... | Gluclub ... | 15 | 7 | 8 | 12 | 10 | 52 |

ROYAL AGRICULTURAL SOCIETY.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| B. W. G. Hopwood | Bencubbin ... | Bencubbin ... | 19 | 8 | 9 | 14 | 13 | 63 |

## ZONE 5.

### Judge: R. P. Roberts, Agricultural Adviser.

Bruce Rock Society—8 entries; Merredin Society—7 entries.

The rainfalls recorded for the year at Yarding, Kumminin, Belka, Ulva, Merredin, Bruce Rock, Koonadgin, and Baandee are given in the following table:—

| Station. | Jan. | Feb. | Mar. | Apl. | Growing Period. May. | June. | July. | Aug. | Sept. | Oct. | Total. | Nov. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Merredin ... | 92 | 2 | 52 | 11 | 90 | 231 | 143 | 172 | 54 | 14 | 704 | 43 |
| Bruce Rock ... | 40 | 14 | 15 | 15 | 120 | 203 | 102 | 185 | 97 | 12 | 719 | 35 |
| Kumminin ... | 52 | ... | 25 | 12 | 146 | 256 | 116 | 178 | 79 | ... | 775 | ... |
| Belka ... ... | 36 | 35 | 10 | 73 | ... | 84 | 224 | 97 | No Record. | | | |
| Ulva ... ... | 116 | 20 | 74 | 15 | 89 | 179 | 172 | 171 | 73 | 20 | 704 | 7 |
| Baandee ... ... | 42 | ... | 23 | ... | 73 | 168 | 106 | 135 | 65 | 5 | 552 | ... |
| Yarding ... ... | 42 | 7 | 74 | 3 | 136 | 259 | 114 | 198 | 70 | 10 | 787 | ... |
| Koonadgin ... | 45 | ... | 64 | 3 | 110 | 232 | 138 | 151 | 65 | ... | 696 | 23 |

The results of the two competitions are given below:—

BRUCE ROCK AGRICULTURAL SOCIETY.

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts |
| E. G. Ellis ... | Kumminin ... | Bencubbin ... | 28 | 9 | 9 | 13 | 12 | 71 |
| J. Starcevitch ... | Korbel ... | do. ... | 22 | 9 | 9 | 13 | 13 | 66 |
| F. C. Farrall & Son | Yarding ... | Gluclub ... | 24 | 7 | 8 | 12 | 13 | 64 |
| S. H. Pimlott ... | Kwolyin ... | Totadgin ... | 22 | 8 | 9 | 13 | 12 | 64 |
| H. Farrall ... | Yarding ... | Bencubbin ... | 22 | 9 | 9 | 12 | 12 | 64 |
| C. C. Perkins ... | Belka ... ... | Totadgin ... | 21 | 9 | 9 | 12 | 13 | 64 |
| C. Smith & Sons | Yarding ... | Bencubbin ... | 20 | 8 | 9 | 13 | 12 | 62 |
| P. A. Strange ... | do. ... | Gluclub ... | 17 | 8 | 9 | 13 | 12 | 59 |

MERREDIN AGRICULTURAL SOCIETY.

| Competitor. | Address. | Variety. | Yield. | Freedom from Weeds. | Freedom from Disease. | Freedom from Admixture. | Evenness of Growth. | Total. |
|---|---|---|---|---|---|---|---|---|
| | | | 50 pts. | 10 pts. | 10 pts. | 15 pts. | 15 pts. | 100 pts. |
| McPharlin & Sons | South Burracoppin | Bencubbin ... | 24 | 8 | 9 | 14 | 13 | 68 |
| J. D. Thynne ... | Norpa ... | do. ... | 23 | 8 | 9 | 14 | 13 | 67 |
| I. H. Flockart ... | Korbel ... | do. ... | 17 | 8 | 9 | 14 | 12 | 60 |
| H. W. Teasdale ... | Ulva ... ... | Totadgin ... | 17 | 7 | 9 | 14 | 11 | 58 |
| W. S. Crouch ... | South Wal-goolan | do. ... | 16 | 8 | 9 | 13 | 11 | 57 |
| J. Kay ... ... | Baandee ... | Bencubbin ... | 13 | 6 | 9 | 13 | 12 | 53 |
| J. Clothier ... | Ulva ... ... | Totadgin ... | 12 | 7 | 9 | 14 | 11 | 53 |

*To be continued.*

## RABBIT DESTRUCTION.

A. ARNOLD, Chief Inspector of Rabbits.

Now that harvesting operations are over, Vermin Boards generally are showing a desire to cope with the rabbit problem.

The dry season, together with other causes, has reduced the pest to a minimum, more especially in the drier areas, but it is noticed that along the watercourses, creeks, etc., in the more favourable districts, a serious situation is likely to develop, unless those responsible are dominated by a sense of their responsibility to their neighbours, themselves, and the State.

During the summer the pest is forced to congregate around water, where they can be readily dealt with, and on account of the pest being at a minimum, the present offers a wonderful opportunity of effectively dealing with it by further reducing the numbers before the breeding season commences. It therefore behoves Vermin Boards to press the work of destruction within their districts; a few badly infested and neglected spots can nullify any of the work done, and easily reinfest the whole area. Taking advantage of the fact that rabbits live colony-wise around water during the summer, no method should be adopted that would tend to disturb or frighten them; it would be a far wiser plan to adopt a course of free feeding and subsequent poisoning: a clean sweep can often be achieved by following this method—by first liberally feeding and then poisoning; however, no one method alone can be relied on.

In surface covered country, which affords abundant shelter and harbour for the pest, it is essential that systematic poisoning should be undertaken, but in country in which there is no surface cover, fumigation, digging in, and digging out, and constant attention with pick and shovel, preventing the reopening of the burrows, is necessary. The eradication of the pest should be aimed at; all known and approved methods must be employed, and thoroughness is essential.

As already indicated, rabbits at present are down in numbers, therefore the present offers a wonderful opportunity to keep them down, and land owners should do everything to assist the local Inspector and Vermin Boards in their efforts to keep them down, bearing in mind that there is not any improvement that could be undertaken on the farm that will give such a substantial return as the destruction of rabbits.

# USEFUL BIRDS OF WESTERN AUSTRALIA.

## SERIES IV.

## SWALLOWS AND MARTINS.

C. F. H. Jenkins, B.A.,
Assistant Entomologist.

The Swallow family (*Hirundinidae*) is world wide in its distribution and contains some of the most useful and best known of our feathered friends.

In Australia it has four representatives, the Welcome Swallow (*Hirundo neoxena*), the White Backed Swallow (*Cheramoeca leucosterna*), the Tree Martin (*Hylochelidon nigricans*), and the Fairy Martin (*H. ariel*), and all of these are to be met with in our own State.

Two foreign species of this group which have touched the northern shores of the continent are European Swallow (*Hirundo rustica*) and the Eastern Swallow (*H. javanica*), but such strays cannot really be included as members of the Australian avifauna.

Without doubt the best known member of the family is the Welcome Swallow (*Hirundo neoxena*) for it ranges over the whole of the continent with the exception of the Northern Territory and Nothern Queensland and makes itself at home about human habitations in town and country.

On this account it is surprising to find that there are still many people who confuse the swallow with some of its less known relatives and so a brief description of all the species concerned will not be out of place.

The Swallow is the largest of the local species, measuring about six inches from the beak to the tip of the tail. The latter is prominently forked and marked with a band of whitish spots. The back and rump are glossy black, the wings dark brown, the under surface dirty white, and the breast, throat and forehead rust red.

Tree Martins and Fairy Martins are often incorrectly called Swallows on account of their similar general appearance and habits, but they are smaller than the true swallow, have a whitish patch on the rump, quite prominent in flying birds, and a less markedly forked tail, which is a very useful point of distinction.

Swallows are among those birds which readily adapt themselves to the changes wrought by civilisation. Before the advent of the white man, burned out trees, caves and overhanging cliffs served as shelters for their cup-shaped mud nests, but it was not long before bridges, sheds and verandahs were found to be just as serviceable and much more accessible, so that to-day the birds may be said to be almost semi-domesticated.

The usual breeding months of the swallow are from September to the end of the year. Three to five eggs form the clutch. They measure about three-quarters of an inch in length and have a pinkish white ground, speckled with reddish-brown and slate particularly towards the larger end.

As is well known the food of the swallow consists almost exclusively of insects and its soft broad beak, wide gape, and remarkable powers of flight, make it admirably adapted for feeding upon the more active aerial forms.

Almost as common as the preceding species is the Tree Martin, sometimes called the tree swallow. It ranges over the whole of Australia and extends to New Guinea and many of the adjacent islands. Slightly smaller than the swallow, this bird measures about 5 inches in length. The head and back are black, the

under parts and rump dirty white, and the forehead rust red. The tail is only slightly forked. As its name signifies, this martin is principally arboreal in its habits, and small flocks may frequently be seen haunting trees in the vicinity of a watercourse. Unlike the majority of its relatives, this species does not build a mud nest but lays its eggs in the hollow spout of a tree. A few dead leaves are strewn on the decaying wood lying on the floor of the hollow, and on these the eggs are laid. Should the opening to the hollow be too large, however, the birds may reduce the aperture with a little mud plaster, showing that they, too, have inherited the ability of working clay when the necessity arises.

Tree Martins.

Household duties are commenced about July or August and nests may contain young as late as February. Three white eggs speckled with reddish brown and measuring just under ¾in. in length, constitute the clutch. In a favourable tree as many as twenty birds may find nesting sites and when the young are hatched a very animated scene is presented as the parents dart in an out at the entrances in their attempt to appease the appetites of their offspring.

Like the swallow the Tree Martin has an insectivorous diet and is admirably adapted for catching prey on the wing.

The Fairy Martin is a much rarer bird than the Tree Martin in this State and is almost indistinguishable from it under field conditions. A comparison of the two birds, however, shows that the rusty colouring of the head is much more extensive in the Fairy Martin than in the latter species where it is confined to the forehead. Their nesting habits are also quite different, the Fairy Martin having earned for itself the name of Bottle Swallow and Retort Swallow on account of the peculiar mud structures which it builds. Bridges, caves and culverts often shelter

the homes of this species, and a number of birds usually nest together. Three to four eggs are laid and frequently they are pure white in colour but faint brownish markings are not uncommon.

The last member of the family with which we have to deal is the Black and White Swallow, quite the rarest member of the group, but one which is easily recognised. The forehead, crown and upper back are pure white, the hind neck brown and the remainder of the upper surface black. The fore neck, chest and under wing coverts are white and the remainder of the under surface black.

These swallows are usually met with in pairs or small companies and frequent the drier regions of the continent. They are seldom seen in the lower South-West, but from Northam eastwards and northwards they are usually to be encountered. The breeding habits of the White-backed Swallow are quite unique as far as Australian members of the family are concerned, but may be compared with those of the European Sand Martin.

The eggs are laid at the end of a tunnel drilled into the side of a creek bank or cutting. After penetrating for about 30 inches the tunnel opens out into a nesting chamber and here a cup-shaped nest, to hold the three to five white eggs, is constructed. In farming areas grass and straw are commonly utilised for building material, but near the sea-coast seaweed is not uncommonly put to this use. Nests have been found containing as many as nine eggs, but there is little doubt that more than one female was responsible for this unusual number.

Where suitable nesting sites are rare the burrows of rabbits and bandicoots are sometimes appropriated and some instances have been noticed where the bird has drilled its mouse-like hole in the wall of a burrow so that the larger opening serves as a common exit for both bird and beast.

Like many inhabitants of the interior this swallow is rather erratic in its movements; it may haunt a district for months at a time and then disapear for an equally long period; it is not, however, a true migrant and seems to be controlled only by the weather and its own whims and fancies.

In this State none of the swallow tribe appears to have any very extensive migration movements; in some of the colder parts of the Eastern States migrations more or less comparable to those undertaken by their European relatives are witnessed but the population density varies very little in most local districts from one season to another.

It is perhaps unnecessary to say that all swallows and martins are entirely useful birds. They feed exclusively on insects, and on account of their slightly different habits, control a wide range of flying insects. The two species of martins are usually found hawking in close proximity to water, often flying low over its surface. The common swallow haunts higher in the air and the White-backed Swallow is probably the highest flier of them all, so that each strata of the air is patrolled by one or other species.

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## WHITE WINGED TRILLER.

*(Lalage tricolor.)*

The White Winged Triller, or White Winged Caterpillar-Eater, is one of the most charming birds of the Australian bush, for although not brilliantly coloured, the male, with its black and white plumage, always has an attractive appearance, and its voice has few superiors in any part of the world. The remarkable vocal powers of this species have been commented upon by many writers and evidently impressed themselves forcibly upon the first discoverer of this genus, for the name Lalage, originally used by the poet Horace for a "sweetly smiling, sweetly speaking" girl was appropriately made use of in the scientific description of this group.

The male Triller measures a little over six inches in length and the upper parts are jet black with the exception of the lower back which is grey. The wings are black with prominent white shoulder marks and the under surface is pure white.

The female is much more sombre hued than her mate, the upper parts being brown, and the ventral surface dirty white.

The diet of this bird is exclusively insectivorous, and as the name caterillar eater implies, lepidopterous larvae are extensively hunted, but food is also captured on the wing, the bird making short flights in pursuit of moths, beetles, flies, etc.

White-winged Triller.

The Triller is a migratory species spending the winter in the northern parts of the continent and coming south for the breeding season. The advance guard, consisting mainly of males, arrives about August, and nesting activities usually commence the following month. The return trip northwards is undertaken about January or February and nothing more is seen of the birds until the next spring, or perhaps longer, as, although migratory, these birds do not follow definite routes, and the numbers visiting a given district each year vary considerably according to seasonal and other conditions.

The nest is a very tiny structure compared with the size of the bird, and is constructed of plant stems, roots and fibres bound together with cobwebs. It is usually placed in a horizontal fork at no great height from the ground, but so well does it harmonise with its surroundings that it is very difficult to locate unless its presence is betrayed by the pugnacity of the brooding parents, who will not hesitate to attack anyone encroaching on their domain. Two to three eggs, greenish in ground colour, thickly blotched with reddish brown, constitute the clutch, and both parents take their turn at incubating the eggs.

The White Winged Triller has been recorded from all over the Continent and extends to New Guinea, with a stray bird occurring in Tasmania. It has a close relative in the Varied Triller of Tropical Australia and several of the Pacific Islands, but only the one species occurs in our own State.

There is no need to emphasise the usefulness of the species under discussion, for the value of such an insect destroyer must be apparent to all, also its canary-like song, although of no economic value, serves as an additional reason for protecting and harbouring to the utmost extent this attractive bird.

## THE WESTERN WARBLER.

*(Gerygone fusca.)*

The Western Warbler, sometimes known as the Southern Warbler, or Southern Fly Catcher, is quite common in the forest and scrub country of this State, but on account of its retiring habits and sombre plumage, it is not a well

Western Warbler and Nest.

known bird. It is about the size and build of the common Silver Eye, measuring a little under four inches from the tip of the bill to the end of the tail. The general colouration of the bird is greyish brown, the upper parts being olive brown, the throat and chest light grey and the abdomen white. The tail is white at the base, but dark towards the middle, and the tip is furnished with a row of white spots.

This bird usually haunts the leafy tops of the trees where it may sometimes be seen hovering in search of insects, but frequently its presence is only betrayed by its high pitched plaintive whistle which is uttered very persistently, and has earned for its owner the colloquial name of Sleepy Dick, on account of the drowsy intonation of the voice.

The nest of the Western Warbler is a very beautifully built structure composed of dry grass and root fibres and lined with feathers. It is hung from a thin twig and the hooded entrance is constructed on the side. The bottom of the nest is finished off with a wisp-like tail of grass several inches long, the purpose of which is not at all evident. Three flesh coloured eggs, covered with tiny reddish brown spots constitute the clutch, and both parents take a turn on the nest. As the name Fly-Catcher implies the diet of this bird is insectivorous, and there is little doubt that the health of many of our forest trees is closely bound up with the presence of these and other birds of similar habits, which patrol the foliage and help to keep it free from insect infestation.

The Western Warbler has a wide range over this State and a fairly extended habitat in the Eastern States. It has a number of close relatives in various parts of the continent differing chiefly as regards details of plumage. The Tom-tits and Thornbills are closely related to the Warblers and have much in common as regards both habits and distribution.

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## THE EVOLUTION OF THE AUSTRALIAN MERINO.

### A REVIEW.

The story of the development of the Australian Merino is a romantic one. The national economic result is surely far greater than even the pioneers of the Merino sheep industry in Australia ever imagined. It is difficult indeed to picture Australia without its world famous sheep. From the low yielding type of Spanish Merino has been developed, in a period of about 140 years, the shapely, aristocratic, high yielding quality wool sheep of to-day.

In his book "The Evolution of the Australian Merino," Mr. E. W. Cox, a descendant of one of the foremost pioneers in this work, has traced that development.

It is increasingly evident as one progresses from chapter to chapter that this work has called for much patient endeavour to give such a comprehensive historical treatment of the subject.

The book opens with accounts of the first importations of sheep into the colony of New South Wales in 1788. These animals came from the Cape of Good Hope and from India. It was not until 1797 that the Spanish Merino was first landed in Australia by Captains Waterhouse and Kent.

The breeding and improvement effected by Captain MacArthur and his contemporaries, particularly Captain Cox, are fully dealt with and so the historial and practical treatment is continued.

There is a history given of the Spanish Merino with descriptions of its five most important strains, viz., Escurial, Paular, Infantado, Negrette and Guadalupe. In summarising the origin of the Australian Merino, Mr. Cox states:—"Spain, Saxony, Germany, England, France, America, these have been the sources of supply of Merino blood for Australia. From Saxony the great bulk of the blood has come and the best results. But it has been the fusion of the Saxony, German, Rambouillet and English strains that has evolved the Australian type."

In Chapter 2 the introduction and development of the Merino in Tasmania is described and subsequent chapters deal similarly with Victoria, South Australia, Queensland and Western Australia in that order.

Mr. Cox follows with an analysis of the causes of success and gives an excellent section on breeding with particular reference to in-breeding.

Outlines for future development are suggested.

The book is brought to a close on a practical note with remarks on the founding of a flock and the causes and remedies of unnecessary mortality.

Much has been written from time to time on the histories of the individual strains and studs of the Australian Merino, but this book is particularly valuable as a comprehensive treatise outlining all the main phases of the breeding operations since the introduction of the Merino into the Colony some 140 years ago.

The publication is, of course, most suited to the stud breeder, but as a means of obtaining a conception of the breeding which lies behind the present day Merino, it is well worthy of its place on any agriculturist's or pastoralist's bookshelf.

"The Evolution of the Australian Merino," by E. W. Cox. Publishers Angus and Robertson. Price 21s.

## 50-ACRE CROP COMPETITIONS, 1936.

### WYALKATCHEM AGRICULTURAL SOCIETY.

Judge: W. M. Nunn, Agricultural Adviser.

There were two entrants for the competition conducted by the Wyalkatchem Agricultural Society, but unfortunately the entries were received too late for them to be included in the Royal Agricultural Society's competition in Zone 3.

The competion was won by Mr. W. W. Jones, of Cowcowing, with a crop of the variety "Bencubbin." The land, which originally carried Salmon Gum and Gimlet timber, was worked with a scarifier in June, 1935, to a depth of 3 inches and was again scarified in August. Seeding was carried out during the first week in May with a combined cultivator drill, the rates of seed and superphosphate being 50 and 90 lbs., respectively. The seed was graded and treated with copper carbonate. This crop was well grown and even and very free from weeds and admixture. Its yield of 26 bushels must be considered very good in view of the adverse seasonal conditions experienced.

Mr. C. W. Maitland's crop of Bencubbin on land which had originally carried Salmon Gum and Gimlet, was preceded by two consecutive years of fallow. It was scarified in June, 1934, and again in June, 1935, and cultivated in the following August and in March, 1936.

Seeding was done with the combined cultivator drill during the first week in May, 50 lbs. of seed (graded and treated with copper carbonate) and 90 lbs. of superphosphate per acre being used. This crop also was very well grown, even and clean, and was only narrowly beaten by that of Mr. W. W. Jones.

The rainfalls recorded at Wyalkatchem and at Cowcowing are as follow:—

| | | | | | Growing Period. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Jan. | Feb. | Mar. | April. | May. | June. | July. | August. | Sept. | Oct. | Total. |
| Wyalkatchem... | 51 | 5 | 67 | 6 | 93 | 217 | 110 | 179 | 64 | 22 | 685 |
| Cowcowing ... | 13 | | no record | | 99 | 252 | 86 | 123 | 49 | 41 | 650 |

The judge's awards are given below:—

| Competitor. | Address. | Variety. | Yield. 50 points. | Freedom from Weeds. 10 points. | Freedom from Disease. 10 points. | Freedom from Admixture. 15 points. | Evenness of Growth. 15 points. | Total. 100 points. |
|---|---|---|---|---|---|---|---|---|
| W. W. Jones | Cowcowing ... | Bencubbin | 26 | 9 | 8 | 14 | 14 | 71 |
| C. W. Maitland | Wyalkatchem | Bencubbin | 23 | 8 | 8 | 14 | 13 | 66 |

## PIGS: BREEDING AND MANAGEMENT.

G. K. Baron-Hay,
Superintendent of Dairying.

It is strange that while the production of grain, particularly wheat, in Western Australia increased phenomenally until 1929, and that simultaneously with this movement large areas of land were developed in the wetter districts of the State considered suitable for dairy farming, the production of bacon and pork has not increased commensurately.

Experiences in other countries have shown that pig-raising is profitable where either one of two conditions regarding raw food material exists.

(a) The presence of cheap home-grown grain.

In the United States of America, the States where wheat and maize are grown in large quantities, particularly the latter, are those in which pig-raising predominates. In Queensland, where maize can be grown profitably, the pig-raising industry is an important one. In this State, similar conditions prevail in the wheat belt areas, and it is surprising that, during the last five years when wheat prices were low, the raising of pigs has not been more generally carried out in these areas.

(b) Pig-raising as an adjunct to dairy farming.

Pig-raising also is profitable as an adjunct to dairy farming where large quantities of skim milk are available for feeding to the pigs. This is the condition under which the industry is conducted in Denmark (Europe) and in New Zealand.

With the development of the dairying industry in this State, it is essential that pig-raising should be looked upon as an integral part of dairy farming, in order that the highest returns may be obtained from this industry. While specialised pig farms do exist on which large herds of pigs are kept, the general rule is for this industry to be associated with some other form of farming.

As is shown in the graph attached, pig farming has not progressed in Western Australia commensurate with the increase in dairy cattle or with the development of the South-West portion of the State. It will be noticed that the pig population has fluctuated from year to year, but has remained on the average constant, while the number of dairy cattle has shown a continued increase. There is also an excellent market for local pig products, as indicated in the following table, which, however, is now well supplied, and it will be necessary to develop the export trade in pork and bacon.

TABLE 1.

| | 1924-25 | 1929-30 | 1934-35 |
|---|---|---|---|
| | £ | £ | £ |
| Consumption .. .. | 356,426 | 515,473 | 387,858 |
| Production .. .. | 137,221 | 271,900 | 377,090 |
| Local Market available .. | 219,205 | 243,573 | 10,768 |

The rapid fluctuation of the pig population is in itself an argument in favour of developing the pig industry, as it indicates the capacity of the pig above all other farm animals for rapid reproduction. Other stock are only able to increase at a very slow rate in comparison as shown below:—

| | Annual Increase Per Cent. |
|---|---|
| Cattle .. .. .. .. .. | 80—90 |
| Sheep .. .. .. .. .. | 95—115 |
| Pigs .. .. .. .. .. | 1200–1800 |

In addition to this, pigs produce more edible flesh from a given quantity of food than other farm animals. It requires 13 lb. of dry matter fed to cattle to return 1 lb. of beef; 8 to 9 lb. to produce 1 lb. of mutton; while the pig will return 1 lb. of pork for from 4 to 5 lb. of dry matter consumed. Also, when slaughtered, pigs return by far the greatest proportion of their carcase as edible flesh compared with cattle and sheep. Cattle return 60 to 65 per cent. of their carcase weight; sheep dress 55 to 60 per cent.; while pigs will return 78 to 80 per cent. of their carcase weight.

Further, pigs can be successfully bred, reared, and fattened on smaller areas than other domestic animals, which results in a smaller capital outlay in pig-raising in comparison with the income obtained than with other branches of stock-raising.

When it also is recognised that the pig possesses a voracious appetite and is able to digest almost any class of food, much of which otherwise would be wasted, it may be looked upon as the scavenger of the farm and the most economic adjunct to farm life.

In spite of these facts, however, pig-raising has not attained the importance in Western Australia that might be expected. Several reasons are advanced for the apparent unpopularity of the industry—

1. Fluctuation in prices of pig products.
2. Fluctuation in prices of foodstuffs.
3. Disease.

1. *Fluctuation in prices of pig products.*

The fluctuation in prices of pig products is not a local phenomenon, but is apparently a feature of the world trade in these products. In European countries an attempt has been made to work out a definite periodicity curve for the

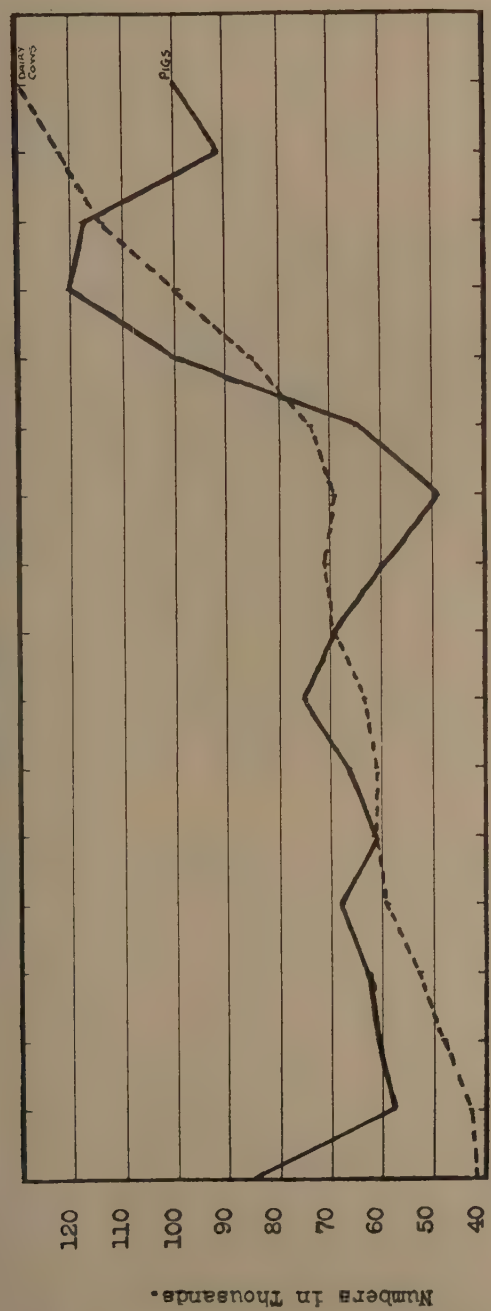


Fig. 1.
Fluctuation in Pig Population compared with number of Dairy Cows.

prices of pig products, and investigations have shown that a definite cycle can be observed between high prices and low production, and, conversely, low prices and high production. These cycles vary from 3 to 4 years. This fluctuation is ascribed tentatively to rapid over-production causing a fall in price, and as rapid a fall in production consequent on dissatisfaction with the low price, causing a scarcity and, again, a rise in price. Owing to the rapidity with which the number of pigs can be increased, the whole cycle takes approximately four years.

Looking at the graph which depicts the rise and fall in the population of pigs, it appears that this cycle is somewhat shorter in Western Australia, being about three years, though information is not available for a sufficient length of time in order to rely on such a rise and fall in price taking place regularly.

2. *Fluctuation in prices of foodstuffs.*

Suggestions have been made that periodical fluctuations in the pig population have been caused by the price of the main feeding stuffs in Western Australia—wheat or its products. This may to a certain extent be true, but, in Germany, an elaborate examination of the prices of foodstuffs and the number of pigs discounts the theory that there is a close association between the cycle of pig production and the prices of foodstuffs.

It will be seen in the graph that apparently the curve for pig population bears no relation to the price of wheat. The rise in pig population in 1928 normally would have occurred without the fall in wheat prices which commenced in 1929, and, although wheat prices were very low in the years 1931, 1932, and 1933, the usual fall in pig population occurred.

On only a few farms in this State has an attempt been made to provide the majority of foods required for the production of bacon, and these farms are more or less free from the effects of fluctuation in the prices of foodstuffs, particularly pollard, which in the dairy belt has been the main concentrate fed to pigs. By attention to the provision of home-grown fodder, the disability of relying on purchased foods which fluctuate in value is in a great part removed.

3. *Disease.*

Disease has been advanced as a reason for the fluctuation in our pig population, but this State has been remarkably free from serious disease during the period under review. The outbreak of swine plague in 1927, though causing a great deal of inconvenience to farmers in the affected area, caused a depletion of not more than 2,000 head of pigs. This outbreak, through creating a fear of disease in the minds of farmers, no doubt did act as a deterrent on those who otherwise may have developed the pig-raising side of their operations.

The percentage of pigs condemned for disease at the Abattoirs now, however, is very light, approximately one per cent., pointing to the healthy condition of our pigs as an average, the principal disease being tuberculosis.

Whatever be the cause or causes of the fluctuation in the number of pigs mentioned above, there is no doubt that farmers have practised an "in-and-out" policy in their pig-farming, endeavouring to come into the business at the top of the market, a policy which benefits only those who remain constantly in the business and can sell their weaner pigs at high prices. A moment's reflection on the price of weaner pigs during the last 18-20 months indicates how profitable these have been to breed, weaner pigs having fetched as high as 30s. per head.

It is believed that, by developing the pig industry on sound and systematic lines, dairy farmers, and in particular those on recently developed farms such as under the Group Settlement Scheme, can convert much of the produce grown

on the farm into a marketable product, namely, bacon, where difficulty would be experienced in doing this should reliance be placed on the cow only which, as has been shown, increases at a low rate, and is difficult to purchase.

It, however, is not sufficient for farmers to rear pigs and forward them to the saleyards. It is imperative that the type of pigs produced should be of such a nature as to be suitable for the trade catering for the needs of the consumers. Also, in view of the comparative smallness of the local market, it is desirable that the producer should have in mind the ultimate necessity of breeding pigs suitable for export, as by far the larger market is provided by the requirements of the British consumers. A very detailed investigation carried out by the Empire Marketing Board in the years 1928 and 1929 provides definite information on this point, and it is fortunate that the present public taste in Great Britain is similar to that in this State, namely, for small lean joints of meat. The system of pig-raising adopted must conform to these requirements. The prospective pig-raiser, therefore, should become au fait with the characteristics and type of those pigs which will supply these requirements, and this can best be obtained by briefly outlining the specifications for porker and bacon pigs as approved by the trade.

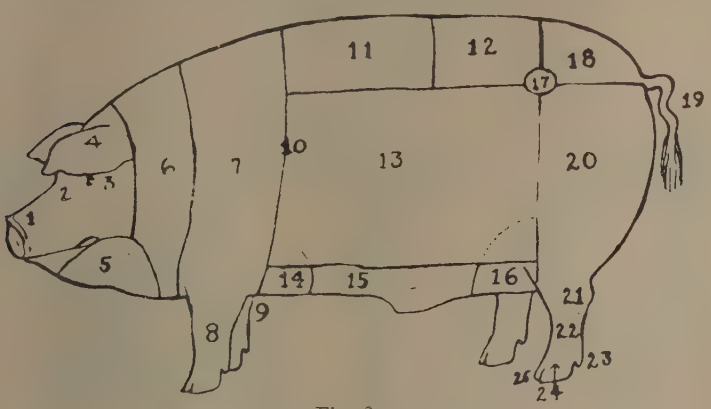


Fig. 2.

**PARTS OF THE PIG.**

| | | | |
|---|---|---|---|
| 1. Snout or nose | 8. Fore leg | 14. Fore flank | 20. Ham |
| 2. Face | 9. Chest | 15. Belly | 21. Hock |
| 3. Eye | 10. Heart girth | 16. Rear flank | 22. Hind leg |
| 4. Ear | 11. Back | 17. Hip | 23. Dew claws |
| 5. Jowl | 12. Loin | 18. Rump | 24. Pasterns |
| 6. Neck | 13. Side | 19. Tail | 25. Toes |
| 7. Shoulder | | | |

## TYPE OF CARCASE.

In view of the desire for leaner joints in both pork and bacon carcases, it is believed that the type, conformation, and general quality of carcases which meet the requirements of bacon curers will meet also those of the pork trade and vice versa, and the experience with recent shipments to Great Britain indicates that this is certainly so as regards the export trade.

It is undesirable and there is no need to introduce complications into pig production by requiring farmers to produce two distinct types of pigs according to whether they wish to supply the pork or the bacon market. In so far as any variations exist in carcases demanded by these two sections of the industry, such variations are those only of weight and not type, given proper methods of feeding.

This is of outstanding importance, as it is often assumed that different breeds or crosses are required to produce animals best suited to the pork and bacon markets respectively.

In order that the description given below of the Standard Pork or Bacon Pig may be understood, the various parts of the pig are indicated in the diagram in Fig. 2.

Carcases for Pork or Bacon should conform to the following specifications:—

## DESCRIPTION OF STANDARD CARCASES FOR PORK OR BACON IN WESTERN AUSTRALIA.

The carcase must be that of a properly fed castrated male or virgin female pig.

The middle portion from the first rib to the hip or aitch bone must be long. The fore end must be light, with a light head and neck, and the hams well developed. Ribs must be well sprung, that is to say, they must not slope rapidly from the backbone, but clearly indicate where the back leaves off and the side begins. The line of the back must be slightly arched from head to tail, and not dished or humped over the shoulder. (See illustration 3.) The neck must be of medium length and devoid of crest. The shoulders must be smooth, slightly rounded from side to side over the top and very compact. The back fat should be even, without pronounced thickening over the shoulder, and it should taper slightly from the shoulder to the rump, and should not be greater than 1½ inches at the shoulder in the bacon pig.

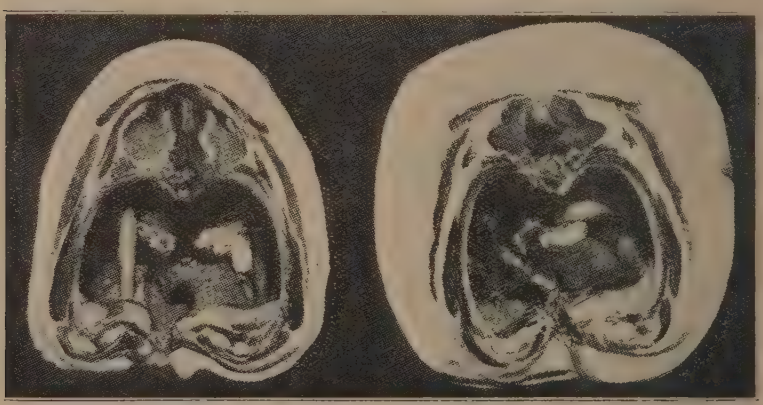

Fig. 3.

A transverse section through the shoulder should be arched. A flat or round section is usually excessively fat, and chest cavity, which holds lung and heart, is restricted.

(Min. of Agric. Report on Emp. Pork and Bacon Trades, 1928.)

The underline must be straight and thick throughout its whole length, entirely free from flabbiness or distention of the flank. Thick lines or streaks of fat should be absent from the visible portion of the lean, and indications of leanness must be visible between the ribs.

The shanks must be short, bone fine, and the fore hock and ham free from wrinkles. The flesh must be carried well around the bone, leaving no bareness inside the thigh and well down to the knee and hock joints.

The vertebrae must be of a flesh pink colour and flinty in texture. The proportion of lean to fat must be good. The fat should be white and firm to the touch; when pressed with the thumb, an indentation should be formed which remains visible for a few minutes after pressure has been removed.

The texture of the lean must be fine grained, and not rough or fibrous. There must be no excess of internal fat—the kidneys should have a thin covering of fat.

The rind must be thin, flesh coloured, perfectly smooth, pliable and free from deep-rooted bristles, and must be devoid of any skin pigmentation. There must be no indication of black bristles and no sign of "seedy cut."

The following carcase weights are in most demand by the trade, and therefore are most profitable to the producer:—

| | Carcase weight. | Live weight. |
|---|---|---|
| | lbs. | lbs. |
| For Porker .. .. .. .. | 50—70 | 72–100 |
| For Bacon—Grade 1 .. .. | 100–115 | 143–164 |
| Prime .. .. | 116–130 | 165–186 |
| Grade 2 .. .. | 131–140 | 186–200 |

Farmers are advised not to market porkers of a less carcase weight than 50 lbs. or a greater weight than 70 lbs., although many such pigs are continually being forwarded to the sales. It is more profitable to "run" a pig over 70 lbs. to the bacon stage, as it is from this weight onwards that a pig shows the greatest daily gain. This weight is also an "out size" and not in demand by either the pork butcher or the bacon curer.

It may be unprofitable to continue to feed pigs beyond the weight desired by the trade because these "out-weights" may be difficult to market and, therefore, are "docked" by the purchaser. The following illustration setting out the relative value per lb. of carcases at different weights and adopting the usual dockages at the prices named demonstrates clearly the advisability of keeping within the grade weights as recommended above:—

| Carcase Weight. | Value per lb. | Value per Carcase at top weight. |
|---|---|---|
| lb. | | £ s. d. |
| 50-70 .. .. .. | 10d. .. .. .. | 2 18 4 |
| 100-115 .. .. .. | 8d. .. .. .. | 3 16 8 |
| 116-130 .. .. .. | 8d. .. .. .. | 4 6 8 |
| 131-140 .. .. .. | 7¾d. .. .. .. | 4 10 5 |
| 141-150 .. .. .. | 7½d. .. .. .. | 4 13 9 |
| 151-160 .. .. .. | 6d. .. .. .. | 4 0 0 |
| 161-180 .. .. .. | 4½d. .. .. .. | 3 7 6 |

A pig weighing 140 lb. carcase weight, therefore, would fetch 3/9 more than one of 130 lb. but has to be fed for at least another 10 days. A pig of 150 lb. weight would only fetch 3s. 4d. more than one at 140 lb. and 7s. 1d. more than one at 130 lb., and has to be kept 10 days and three weeks longer respectively. Beyond this weight of 150 lb. the dockages may be so severe as to actually return a lesser value than if the pig had been sold some weeks previously.

Carcases conforming to the description given above produce a high proportion of the best "cuts" whether as pork or bacon and are the product of selective breeding and correct feeding methods.

With the view of enabling farmers to see the type of pig considered desirable for both local and export trade, the West Australian branch of the Australian Stud Pig Breeders' Association has prepared a chrome nickel model of "The Ideal Bacon Type Pig," which was first exhibited at the Royal Show 1936 and subsequently at as many country shows as possible. This is believed to be the first real effort in Australia for breeders to give a positive lead to farmers regarding type, and indicates their belief that within every breed it is essential to carefully select for the bacon type when considering the purchase or sale of breeding stock.

Fig. 4.

Short undesirable side, with too thick a layer of fat along the back, compared with lengthy side. Both the above sides are the same weight.

(Min. of Agric. Report on Emp. Pork and Bacon Trades, 1928.)

This model pig is illustrated in Fig. 5.

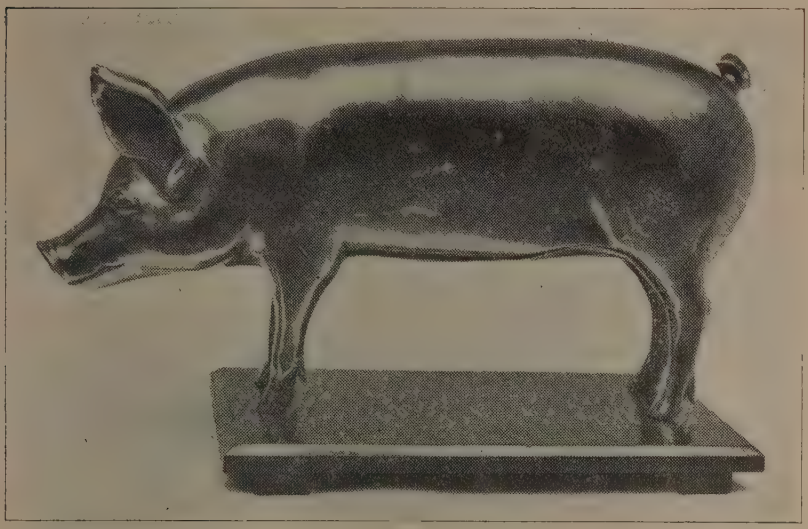

Fig. 5.

Model of Standard Type of Bacon Pig, in chrome-nickel, prepared by Western Australian Branch of Australian Pig Breeders' Association, as a guide to breeders and farmers in the selection of breeding stock for bacon production.

The task of the farmer is to supply the carcase which is described above and which involves two factors—that of "breeding" and "feeding," both of which are considered later in this article.

*Breeds of Pigs.*

Pigs or swine (*Sus scofa*) have existed in a wild state in Europe, Asia, and Africa since the earliest known times, and a close relative is indigenous to the Continent of America. Pigs, however, were unknown in Australia until introduced after colonisation. It is generally accepted that the present day domestic pigs have descended from the wild species. Since the beginning of the Eighteenth Century, a rapid and continuous improvement in the types of a number of breeds of pigs has been effected in England, due to the skill of the English farmer as a stock-breeder and husbandman. Most of the English breeds of to-day have descended from the old English hog with occasional crosses of foreign pigs, particularly Chinese. The domesticated pigs will revert to the wild state if permitted, but the process is comparatively slow, and these pigs do not acquire the solitary habit nor become so fierce as the true wild hog.

Many breeds are recognised throughout the world, but, gradually during the last 100 years, those breeds which have been improved by English breeders have been recognised as of special value for improving native types in various countries. Even in England, however, at least 13 distinct pure breeds are recognised, so that, without special knowledge, the tyro in pig-breeding needs some guidance in the selection of his foundation stock. Four British breeds predominate in Western Australia, and it is proposed to describe only these breeds, as the main points of difference between all breeds are the size of the carcase and bone, the size and

shape of head, length and thickness of neck, length and depth of body and legs, and the colour of the skin and hair, details of which may be obtained from the Breed Societies concerned should a farmer for any particular reason be interested in one of these less numerous breeds.

All the requirements of the existing market, both local and export, can be met by the crosses of the four breeds, now in the State, and there is no useful purpose served by introducing new breeds and thus rendering the work of standardisation of type more difficult.

## BERKSHIRE.

One of the oldest of improved breeds, origin Berkshire, England. Principal improvement in Leicestershire and Staffordshire. The original animal was large, similar to Tamworth, coarse of body, and the colour varied. Marked improvement developed early in 18th century, and was principally effected by Richard Astley and Lord Barrington. Berkshire's were first given a separate class at Royal Agricultural Show, England, in 1862. Early writers show that Chinese pigs were crossed with the Berkshire in their improvement. The improved Berkshire was greatly used on native swine in Ireland and Scotland, with beneficial results. This breed is most widely distributed and popular throughout the world, and does well in all climates.

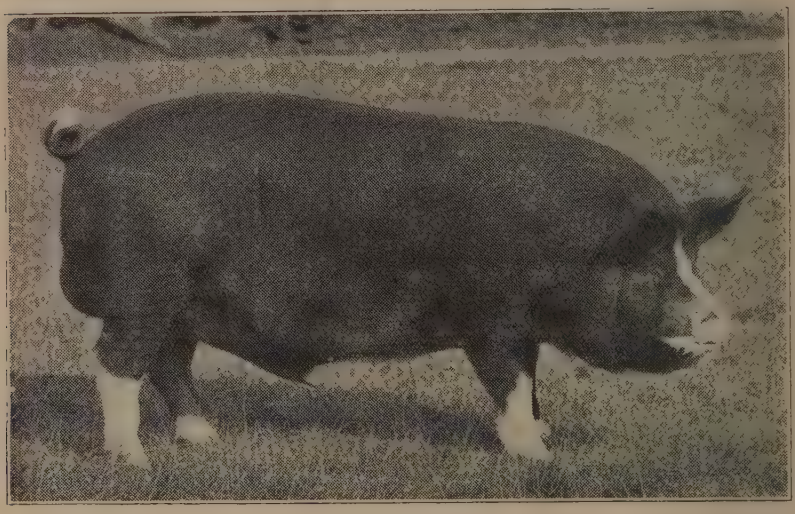

Fig. 6.

Berkshire Boar "Burnham Griqua Gaylad" 4009.

Winner of first prize at the Royal Agricultural Society of England's Show, 1935. Arrived Fremantle by "S.S. Coptic," 9/12/35. Destination—Denmark Research Station. One of four importations made by the Department of Agriculture during 1935.

*Characteristics—*

*Size (relative).*—Medium; larger than Poland-China, smaller than Large Yorkshire, Tamworth, and Large Black.

*Adaptability.*—In general adaptability they may be classed at head of all breeds for pork and bacon.

*Maturing qualities.*—Most excellent. Will fatten at any age.

*Grazing and feeding qualities.*—Splendid; strong digestive powers enable them to give a maximum return in flesh for food consumed.

*Quality of meat.*—Excellent pork and bacon. Well mixed fat and lean. Dresses well in proportion to live weight.

*Value for crossing or "grading-up."*—Unexcelled. Most used in this respect. Great value to refine coarse breeds. Quick growers; early maturers.

*Breeding qualities.*—Medium to good, but vary according to conditions. If not too confined produce fair to good litters, and are fair mothers. Boars are particularly noted for prepotency, and readily impress the young pigs with conformity and early maturing quality.

Fig. 7.

Berkshire Sow, "Burnham Griqua Maid" 14006. P.B.H.E.

Litter sister to boar in use at Denmark Research Station, 1935-6. Note fine shoulders and light head.

*Principal points—*

*Head.*—Medium, broad, fleshy, good width between eyes, well dished, snout short.

*Ears.*—Fairly fine, sprightly, cocked, inclined forward, fringed fine silky hair.

*Jowl.*—Full, firm, symmetrical.

*Neck.*—Short, broad, muscular.

*Shoulders.*—Sloping, freedom from coarseness, thick through chest.

*Back.*—Broad, long, straight or slightly arched.

*Barrel.*—Ribs well sprung, deep, well let down even side and bottom line deep flank; loins strong.

*Rump.*—Wide, lengthy, square, showing strength.

*Hams.*—Deep and thick, well let down, joining back with hock.

*Legs and feet.*—Short, straight, strong, set well apart. Hoofs erect, firm and strong.

*Skin.*—Smooth, pliable, freedom from wrinkles.

*Colour.*—Black, with white blaze on face. White feet and white brush of tail.

*Objections*—

*Snout.*—Long.
*Ears.*—Flopping, coarse.
*Chest.*—Narrow.
*Shoulders.*—Coarse, heavy open on top.
*Back.*—Drooping.
*Sides.*—Flat, not well let down.
*Loin.*—Narrow or weak looking.
*Rump.*—Drooping.
*Hams.*—Narrow, short.
*Legs.*—Crooked, weak, close together, round bone.
*Feet.*—Weak, flat.
*Hair.*—Coarse, curly, bushy fringe on neck.
*Action.*—Sluggish, clumsy.

*Disqualifications*—

Colour.—White, irregularly placed. Reddish hair or spots.

During the last twenty years a type of Berkshire pig specially suited for modern bacon requirements has been developed in Canada. This Canadian or improved Berkshire, as it is known, has been produced as a result of continued selection of bacon type sows and boars, and differs little in conformation from other typical bacon type breeds. The improved Berkshire is rather longer in the snout and lighter in the head and jowl than the older type; the shoulder is finer and more sloping, and the sides flatter, resulting in less loose skin around the belly than in the older pig.

Fig. 8.
Large White Boar, "Wall King David 59th" 91213. S.P.B.H.E.

## YORKSHIRE.

Origin Yorkshire, England. Bred from the old English hog, a large white animal. The small Yorkshire derives its refinement to Chinese crosses, and the Middle Yorkshire to a cross between the two. The Middle Yorkshire was classed separately in 1852. Improvement commenced about 150 years ago. Yorkshire blood widely diffused throughout the world in all white breeds.

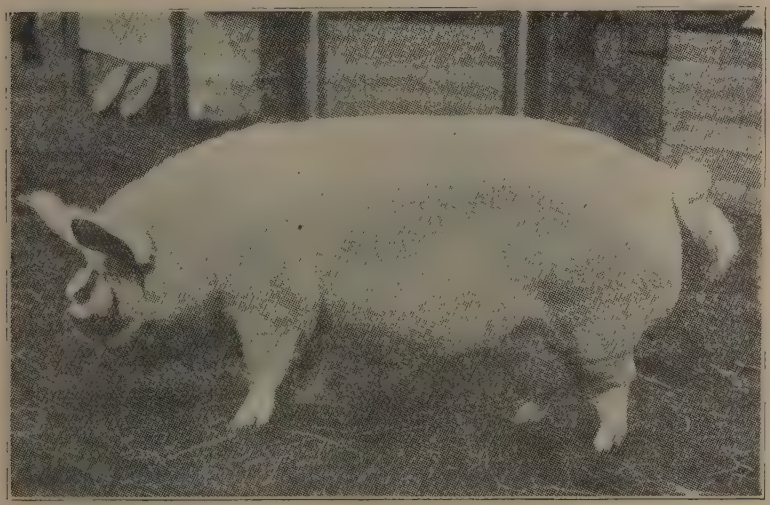

Fig. 9.
Middle White Sow, "Newton Nightingale 3rd" 218458. S.P.B.H., Eng.

*Characteristics of Large Yorkshire or "Large White."*

*Relative size.*—The Large Yorkshire is probably the largest of the breeds, and one of the heaviest, if not the heaviest. Middle Yorkshire and Small describe their size.

*Adaptability.*—Good for bacon and pork, especially where large sides are required. Good doers, good for crossing upon weaker types. Inclined to sun scald; prefers cool climates owing to this liability.

*Maturing qualities.*—Large Yorkshire, not so quick as smaller varieties. Requires from six to eight months for market bacon.

*Grazing and feeding qualities.*—Graze and forage well in cool climate. Gentle disposition. Must be plentifully supplied with food to make economical flesh. Look wretched out of condition, then compare unfavourably with black breeds. Not as hardy as Berkshire. Good growers, especially if sty-fed.

*Quality of meat.*—Good, especially for large "side" markets. Fat and lean fairly well balanced. The Small Yorkshire excels as a porker.

*Value for crossing or grading.*—For small fine-boned sows good, will increase size, improve vigour, improve quality of meat, and increase prolificacy.

*Breeding qualities.*—Good, regular large litters and good mothers. Good tempered, gentle and tractable.

*Principal points—*

*Head.*—Long, lightish, wide between eyes.
*Ears.*—Long, fine, inclined forward.
*Jowl.*—Light.

*Neck.*—Long muscular.

*Shoulders.*—Sloping, no coarseness.

*Back.*—Long, wide, straight or slightly arched.

*Barrel.*—Deep, full rounded, well sprung ribs, flanks well let down, long, wide, square.

*Hams.*—Broad, full meat to hocks.

*Legs.*—Straight and strong.

*Feet.*—Firm.

*Skin.*—Cream colour, freedom from wrinkles or dark spots.

*Colour.*—Pure white.

*Objections.*—Ears, coarse, flopping; shoulders, coarse; weak back; unshapely hams; weak loins; crooked legs; weak feet; coarse curly hair; action, sluggish.

*Disqualifications.*—Black or red hair or spots on skin.

Middle Yorkshire differs from Large Yorkshire in reduction in size, weight, length, and has a distinctly short snub nose and short neck.

## TAMWORTH.

Derive name from Tamworth, Staffordshire, England, where they have been bred for a long period. They are probably the oldest and purest of all breeds in England. This (as in all breeds of pure animals) accounts for the wonderful,

Fig. 10.
Tamworth Boar "Berkswell Up-to-Date 4th" 78813. S.P.B.H., Eng.
Improved type, note hams, capacious body, small head.

marked prepotency of the Tamworth. At the beginning of the 18th century they were noted for large proportion of lean meat they produced. Have been greatly improved by selection, but it is generally conceded that no mixture of the breeds has been introduced in improvement. As early as 1847 they were given premier honours in competition with other large breeds at Royal Agricultural Show, England. Following this they went out of favour, but regained popularity from 1880 onwards.

*Characteristics—*

*Relative size.*—At least second to Large Yorkshire, and in some cases even larger. Hardihood and vigour in keeping with size.

*Adaptability.*—Unexcelled.

*Maturing qualities.*—Comparatively slow, not equal to the smaller or refined breeds.

*Grazing and feeding qualities.*—Excellent grazers, wonderful foragers. Exceptionally hardy; will stand forced feeding. Very suitable open conditions. Powerful digestion, but must not check growth.

*Quality of meat.*—Excellent on account of leanness. Exceptionally good to cross with to improve meat for bacon. Less waste in cooking, good flavour.

*Value for crossing or "grading up."*—Excellent when crossed with small compact over refined grade sow. Impart size, development, vigour, and prolificacy, more and better meat (very big factor). Good growers. Good mothers. Excellent travellers to market.

*Breeding qualities.*—Unexcelled for prolificacy and hardiness, freedom of parturition troubles. Ideal mothers, rarely overlies her young, great defenders, good sucklers.

Fig. 11.
Tamworth Gilt, "Inge Velvet" 253930. S.P.B.H., Eng.
Imported for Muresk Agricultural College in 1935.

*Principal points—*

*Head.*—Long, lean, light, tapering to snout.
*Ears.*—Moderate size, fairly erect, pointing forward.
*Jowl.*—Light.
*Neck.*—Long, rather deep than wide, tapering.
*Shoulder.*—Sloping, good thickness through heart.
*Back.*—Moderately wide, long, slightly arched.
*Barrel.*—Long in coupling, deep ribs, well sprung.
*Rump.*—Deep, fairly full, rounded.
*Ham.*—Large, gradually rounded off rather than square.

*Legs.*—Moderately long, strong, firmly placed under body.
*Skin.*—Smooth, plentifully covered with hair.
*Hair.*—Freedom from coarseness.
*Colour.*—Bright golden red, no black.
*Objections.*—Shoulders coarse, open at top. Ribs flat, weak coupling, shallow body.
*Disqualifications.*—Black or white hairs. Black skin.

## BREEDS RECOMMENDED.

As a result of a Conference held in 1930 at which Representatives of Breeders, Curers, and the Royal Agricultural Society were present, it was recommended that the Berkshire and Tamworth breeds and their crosses were most suitable for the production of bacon and pork under Western Australian conditions.

During the last four years a number of experiments have been carried out with these two breeds at the Denmark Research Station, Muresk Agricultural College, and on Mr. W. G. Burges's farm, "Tipperary," York, with a view to ascertaining further information as to the desirability of these two breeds in competition with the Large White Yorkshire breed. As a result, the recommendation is confirmed that the most useful pigs under West Australian conditions are the Tamworth and the Berkshire. Whatever breeds are utilised, however, types of sows and boars should be selected which conform to the bacon type, that is, good length, light shoulder, well developed ham, light jowl and small head.

In further trials where the carcases of various crosses have been forwarded to London, both privately and during the two years that the Perpetual Executors and Trustees Export Pig Trophy was being competed for, the London reports indicate that the Tamworth, the Berkshire, and their crosses were able to produce carcases suitable for the British market. It is not suggested that the Large White and its crosses are not suitable for this purpose and do not produce a desirable type of carcase, but, even in this breed, selection is necessary to obtain a typical bacon carcase, and the average results show no greater percentage of high quality carcases than in the Tamworth-Berkshire cross. Moreover, curers in this State and in Queensland advise that this cross is suitable for their purposes, and a large and profitable export trade in pork has been built up by New Zealand principally with pigs of the Tamworth-Berkshire cross. Therefore, the recommendation is made that good type breeding stock of these two breeds should be purchased by small farmers intending to maintain a few sows.

## BREEDING METHODS.

*In-Breeding.*

Generally speaking, in-breeding with pigs must be handled most carefully. No other class of stock will show the disastrous results of careless in-breeding so quickly, the first evidence being the birth of blind pigs, hermaphodites, and abnormal individuals of all kinds. Mainly, however, the loss is through the weakening of the strain.

In-breeding is employed to improve quality, whilst out-crossing—the opposite of in-breeding—produces strength. In the hands of the expert breeder, in-breeding has its place in the development of type, quality and strength. The commercial farmer, however, would be well advised to depend upon the frequent introduction of fresh blood in the form of pure bred boars of the right type for improving his breeding stock.

*Line-Breeding.*

Although differing only in degree from in-breeding, careful line-breeding has been the origin of many of our best strains of pigs to-day. In this case the blood lines are similar, but the individuals are more distantly related.

*Cross-Breeding.*

The crossing of almost any two pure breeds of pigs usually will result in increased strength and vitality of the offspring. When two breeds of the same type are crossed, this same type is secured in the offspring with increased vigour. Such pigs invariably prove good "doers," thrifty, easy to feed and finish. The Tamworth-Berkshire cross is favoured, the sire being Tamworth. Because it is difficult for a farmer to maintain the two breeds and thus keep ensured a supply of pure bred females, cross-breeding in the true sense is not a widely followed practice, although, if pure bred sows are available for this purpose, the best results are obtained. The crossbred pigs should be used for market purposes only, and there is always the danger of utilising the crossbred progeny as breeders—a practice which frequently is followed by unsatisfactory results.

## GRADING-UP.

The method of breeding which seems to offer the greatest source of revenue from the least expenditure for breeding stock is that of breeding up from common or grade stock through the continued use of pure bred pigs of one breed. Such grade brood sows, however, should not be selected as mothers unless the type which the farmer desires is strongly in evidence. Sows of this description can be procured for a small cash outlay, and, provided care is exercised in selecting a suitable pure bred boar, very rapid progress can be made in the development of a strain of bacon pigs which will produce carcases very little the inferior of the true crossbred or pure bred pig. This method of breeding pigs for market can be relied upon to give increasing numbers of pigs of the right conformation and type, and the percentage of high quality carcases will increase as the concentration of blood of the bacon breeds is increased through subsequent matings. The key to this system of breeding is the selected pure bred boar.

It is regrettable that there are a large number of crossbred boars still being used for breeding purposes, and, when it is realised the large number of pigs which such a boar can produce in even so short a period as twelve months—running into several hundreds—the folly of breeding from such an animal becomes very evident.

"Grading-up" therefore means using pure bred males of one breed for a number of generations. By starting with the ordinary sows available, and continuing the policy without deviation, a concentration of the desirable blood represented by the boar is obtained. By this means the "mongrel" blood is bred out, and a fixed type obtained. To ensure the improvement being continuous, the best sows from each generation should be selected as brood sows, and mated to another boar of the same breed as that started with; the breed of boar should not be changed, otherwise years of careful breeding may be wasted, and, the whole process of grading up would have to be repeated. By such a definite policy as that outlined above, a pig breeder builds up good type and quality, shapely, quick-maturing and profitable commercial pigs.

## SELECTION OF BREEDING STOCK.

*General Considerations.*

Once the decision has been made as to the particular breed that is to be used, then comes a very important phase in pig production—the selection of the proper sows and boars. With dairy cattle to-day, an animal is bought on

its appearance, pedigree and production record. In some countries it is possible to select pigs on a somewhat similar basis, as a result of recording schemes being officially conducted in those countries. Such schemes are costly to conduct and require large numbers of recorded stock to make their conduction possible, and for this reason have not yet been introduced to Western Australia. These schemes enable breeding stock to be selected on the following three factors:—

(1) The ability of a sow to rear a large litter up to weaning stage;
(2) the rate of growth up to the bacon stage;
(3) the quality of the finished product.

In the absence of such recording schemes, animals can only be selected on their pedigree and conformation. The farmer who breeds his own sows is therefore in an advantageous position, as he is able to keep a record of litters, and need keep breeding sows from only the good performers.

In the first instance, a breeding animal should have excellent health and conformation. There are several external characters which are good indications as to the health and constitution of an animal. The hair should have a healthy appearance and be of the right colour, eyes bright and full of life, and also good blood circulation at the extremities, such as the ears, tail and feet. In white pigs the skin should have a rosy colour, and should not be dry, hard and "dead" white; the latter indicates absence of sufficient blood. Hair without any lustre and a pale colour of the mammary glands and scrotum are indications of poor health, and such animals should be discarded.

For a good conformation the breeding animal should show firmness and compactness with medium feeding. Soft and over-developed pigs are undesirable. The skin should be firmly drawn over the body, without wrinkles, and have a good covering of hair between the front legs and over the hams at the back of the sexual organs. Glossy, smooth hair is an indication of good food utilisation. Soft, thick, flabby ears and weak pasterns are bad signs.

## THE HERD BOAR.

The herd boar may be responsible for up to 1,500 progeny during his life, and therefore his selection is a matter of paramount importance to the pig breeder.

On no account should anything but a pure bred boar be considered, and they can always be purchased at reasonable prices from breeders. If it is possible to obtain the information, a boar from a large litter, and from a strain of sows which throws large litters, should be chosen. In addition to pedigree, however, and whatever the breed, there are certain sex characters which should always be manifested by the herd boar. The head should be strong, is longer than that of the female, and should exhibit pronounced masculinity. After about five months of age, males show an increase in the size of head, and thickening of the bones, thus in the mature boar one expects a strong head with what may be regarded a tendency to coarseness, as shown by the thickness of skin and coarse type of hair. Some boars develop shields, which are heavy coverings of tough hide on the shoulders. This is very undesirable, and a boar with smooth shoulders, or whose relatives have this character, should be selected. Although the tendency is for the male to become heavier in front than the female, this should not be excessive, as this character is inherited and passed on to the progeny. The scrotum should be well developed with two testes of equal size. It is fairly common to find young boars with only one testis, and since this is a hereditary condition, such boars should not be used for pedigree breeding.

If a boar is selected as a weaner, he should be fed intelligently with muscle, bone, nerve-tissue-forming foods or protein, his normal growth not checked, and given plenty of exercise. At four months it is advisable to separate him some distance from sows. He should not be used for stud purposes until 8 or 9 months old, and then only sparingly at long intervals—the first season 8 to 10 sows should be the limit, after that up to 40 or 50 sows may be served in the season if he is used judiciously. The boar should be properly penned with ample room for exercise, and provided with shade, shelter, and plenty of clean water. While developing and in season he should be well fed with nitrogenous foods with a reasonable amount of green stuff such as lucerne, peas, vetches and clovers, these being particularly good. When out of service, the ration should be considerably reduced, but the animal should not be allowed to fall away. It is advisable in hot weather or if sluggish to put sows to the boar early in the morning before feeding. If firmly and not harshly treated, viciousness may often be avoided, but in any case it is advisable to cut a boar's tusks—it's a safe policy. On no account should the boar be allowed to run with sows, as it is wasteful, and no record can be kept of farrowing dates.

## THE BROOD SOW.

As the primary object of selecting brood sows is for the specific purpose of breeding stud stock, porkers or baconers, the matter demands a considerable amount of judgment.

The necessity of using a pure bred boar has been already stressed. In the case of sows, however, for stud breeding purity of blood is equally important, but as the raising of porkers and baconers does not necessarily demand the use of pedigreed sows, but rather those possessing certain special characteristics, a description of these qualifications is given. The brood sow must be sound, healthy, and bred from robust, healthy parents. She should possess an inherent maternal instinct, and natural capacity for producing and rearing large litters, in order that a maximum of profit may result.

To insure these points, the sow should be selected from a large litter, and from family strains known to produce large litters. Her colour type and characteristics should be in close conformity with those of the breed she represents.

In temperament she must be docile and contented, and unselfish when rearing her young. She requires to be of an active, thrifty disposition, with a capacity to consume and assimilate large quantities of food to benefit the embryo young or progeny rather than herself.

Soundness of constitution and robustness are indispensable, and these features should be associated with strong jaws, open nostrils, good width between eyes and ears, sloping shoulders (not coarse or open on top), strong, straight or slightly arched back, freedom from weakness at loins, long barrel, deep sides, well sprung ribs, square rump, good hams, sturdy straight legs squarely set on, good feet, smooth mellow hide well covered with soft straight hair, 12 to 14 well placed properly formed teats. Summed up, the essentials are: freedom from coarseness, strength of back and loins, length and depth of sides, good hams, legs and feet, ample evidence of udder development.

## MATING.

A *boar* may be put to light work at nine months old, an age at which if properly fed, his virility and masculine character should be sufficiently developed. Judgment however is required in mating, the size of both the young gilt or the young boar being a guide as much as the age as to whether it is safe to mate the

animals. The male used also should be one that will tend to correct any faults that the female may have, which, however, should be only of a minor manner, otherwise the animals should not be used as breeders.

Well nourished *sows* usually show signs of sexual heat or oestrum when from five to six months old. This condition lasts for three to four days, and recurs every three weeks, until pregnancy occurs. Young sows should not be mated until ten months old, unless unusually well developed for their age. The result from breeding from younger sows, is that their nourishment of the foetus may impose a heavy toll on the vital functions of the mother, her development is limited, and the size and virility of the piglets may suffer.

The normal period of gestation is sixteen weeks (112 days). Under favourable conditions it is possible to rear two litters in twelve months. If permitted the sow will take the boar at the first oestrum period, which occurs three or four days after farrowing. This exerts too great a strain on the sow however, and larger, stronger litters are produced where service is delayed until after the piglets are weaned. Under these circumstances it will be realised that the boar should not be allowed to run with the sows, but should be kept in a separate yard, and only allowed with the sows when a service is desired, the date of which can be noted and the date of birth readily calculated.

While it is possible to obtain two litters in twelve months from sows, under practical farming conditions, such an average is seldom obtained. The practice means that pigs must be weaned at eight weeks of age, which is rather young, ten weeks being better, the weaners by this time being able to fend for themselves, and should suffer no "setback" when entirely removed from the sow. No allowance either is made for pigs failing to conceive, which would still further affect the two litter a year programme. Where a farmer owns a number of sows, say five or more, an average of three litters in twenty-four months can be considered satisfactory.

The best returns will be obtained where the pigs are made to fit in with the other operations of the farm, that is farrowing should be regulated so that the weaners are most numerous when the farm feeds are most numerous.

On the dairy farm, weaners should be available to consume the surplus milk when cows are in full profit and pasture growth good. This would be from May to October, necessitating mating from January to June.

On wheat farms, this period would be after the wheat or barley crop has been harvested, about January to March, in which case special provision must be made to compensate for the absence of skim milk and green pasture.

During pregnancy sows must be allowed plenty of exercise, and this can be insured by keeping all breeding sows on the "open air system," that is allowing them the run of a field, the size being immaterial, and if large enough for grazing so much the better. A weather proof shelter will be required in the winter, but only shade and ample water during the summer months.

## THE PREGNANT SOW.

The pregnant sow is called upon to perform a double function—that of nourishing herself as well as the litter of pigs she is carrying. It is therefore imperative that she receive a ration that will supply all material necessary for body building, and plenty of it. Grazing on lucerne or clover pasturage is of great assistance. Sows however should not be permitted to get overfat. The effect on the litter is nearly as serious as if the sow becomes emaciated and very thin. The over-fat sow is likely to farrow small litters, and often kills a number of pigs by lying or trampling on them. Often too she has not enough milk and is a poor mother.

The best guide as to whether pregnant sows are being sufficiently fed is the condition of the sow herself; if she is getting too fat, then the ration is too liberal and probably contains too much starchy material, such as maize or wheat grains.

## BEFORE FARROWING.

About ten to fourteen days before farrowing is due, the sows should be brought in from the paddock and put in a separate pen. It may be necessary to reduce the ration somewhat until after farrowing as the sows will get less exercise than usual while confined to the farrowing pens. The food can be made more laxative, by increasing green material, the use of bran, or by giving 3-4 ozs. of Epsom salts in the slop if considered necessary.

About 8-12 hours before farrowing the sow will exhibit restlessness, and may be seen gathering straw in her mouth and making a nest. It is inadvisable to have a great quantity of bedding available, as the young pigs get underneath this, and are crushed by the mother.

The farrowing pen need not be elaborate—it should be well ventilated, but not draughty, and should have a stout rail all round the inside, about eight inches from the ground. The young pigs are pushed under this when the sow is lying down, and so avoid being crushed.

The young sow should be closely watched at farrowing time, the after-birth removed, and the blood cleaned up, a little slaked lime being spread about. A taste of blood may mean that the sow develops the habit of eating her young, and then must be fattened and slaughtered.

For the first 24 hours after farrowing, the sow should not receive any food, and after that for the first week the food should be sloppy, laxative and light, a mixture of ground oats and pollard in equal proportions in skim milk being a favourite and satisfactory ration. Plenty of clean water should, however, always be available.

It is inadvisable to lay down the amount of meal to be fed, which will vary with every sow and with every litter. This must be divided by the feeder—as a guide the sow may require 3-4lbs. of meal per day during the first week, increasing to 5-8 lbs. per day at the end of the first month.

During the summer, when no green roughage is available, good meadow hay chaffed, or lucerne chaff that has been soaked for about 12 hours, may be mixed with the meal and fed with satisfactory results. About ½ lb. of chaff per day will be sufficient.

There are usually one or two runts in a large littter, and it will be advisable to destroy these when the piglets are a week old; as they will seldom thrive, in comparison with the rest of the litter, and have to be marketed at a later period.

When the young pigs are three weeks old they should be induced to eat by providing a small trough, which is in a pen made of vertical slabs, about 5 to 6 inches apart, which will permit the piglets to pass through, but will exclude the sow. The sow should be fed three times daily.

At four to five weeks old the young males, if not required for breeding, should be castrated.

## WEANING TIME.

There is a tendency to wean piglets at too young an age—quite commonly weaning is complete by the time piglets are 6 weeks old. This is too young, the pigs generally suffer a check in growth, and take several weeks to recover. Experience has shown that it usually pays to delay weaning until the pigs are 8-10 weeks old, and it will thus be hardly possible to obtain two littters per year.

Weaning should be effected by removing the pigs once and for all from the sow. If they are weaned slowly, by allowing access to the sow at gradually lengthened periods, the young pigs expect the drink, and do not settle down so rapidly as where the change is effected decisively.

If weaned at 8-10 weeks, it will be found that the sow will seldom be inconvenienced by an accumulation of milk, as occurs if weaned at the age of 6 weeks.

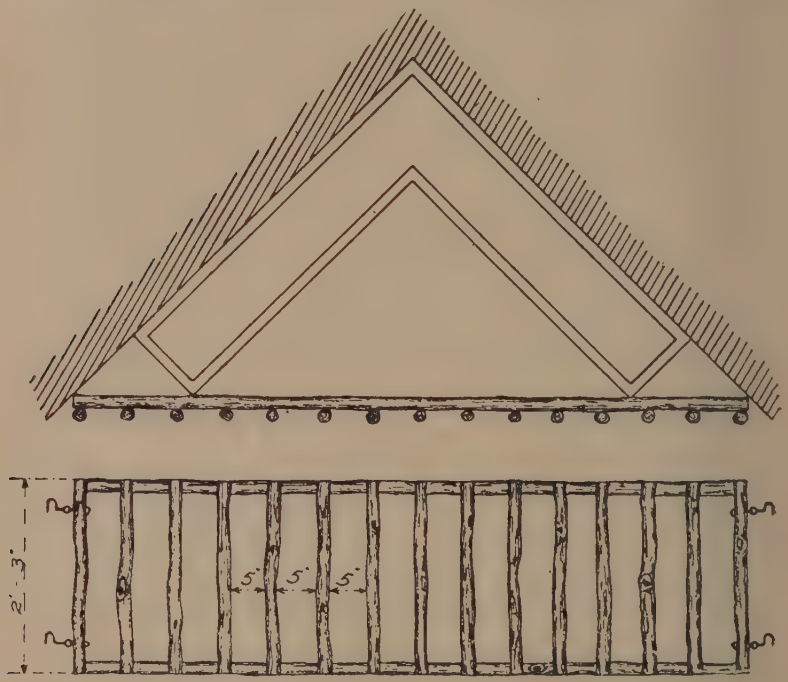


Fig. 12.

Pig Creep used for feeding young pigs prior to weaning.

(Dept. Agric. South Africa.)

## FEEDING THE WEANER.

The most satisfactory ration for weaners is one composed of either separated milk or buttermilk, preferably the former, with one of the following grain concentrates:—ground barley, ground wheat or pollard, in the proportion of three parts by weight of milk to one part of meal. Green roughage should also be available.

In the absence of milk a fairly thin slop with water composed of ground wheat 5 parts, pollard 4 parts, meat meal 1 part has given satisfactory results.

The weaners should be fed only what they will clean up in about 10 minutes, and care should be taken to see that the troughs do not become foul or dirty. By the time the pigs are 12-14 weeks old the critical time after weaning is past, and feeding for either pork or bacon production can be commenced.

## IDENTIFICATION OF PIGS.

It is often convenient on commercial farms and is essential on stud pig farms that some simple method should be available for identifying pigs. Where white pigs are being bred, a tattoo number similar to that which is used for the identification of cattle may be placed in the ear, but no satisfactory ink has yet been found for use with black or red pigs. Tags are often used, but are unsatisfactory, as they tear out very easily. By means of notching the ear, the notch being about half an inch into the ear, an animal can be identified without handling it, and this method is found the most satisfactory.

The following diagram illustrates a method which has been in use for several years in the Department of Agriculture and found satisfactory. Numbers up to 299 may be used by this method and, if different shapes are adopted for the holes in the ears, indicating hundreds, this number may be still further increased, but, as a rule, by the time the final number of 299 is reached, all pigs with the earlier used numbers will have been slaughtered or have died, and a start can be made again with number 1.

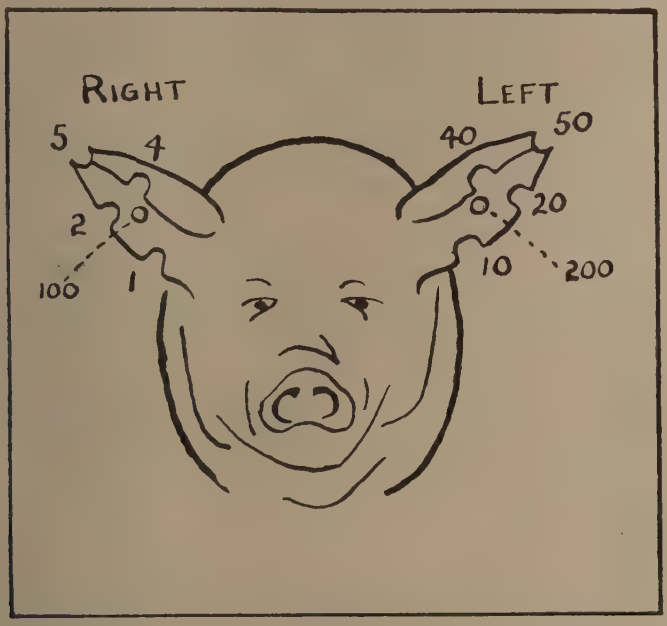


Fig. 13.
No. 3 = Notches 1 and 2; No. 9 = Notes 5 and 4, etc.

## FEEDING.

In providing rations for any animal, the object in view is to adjust the ration so that it may provide the material and energy required to enable the animal to produce the desired result, which is the production of meat in the case of the pig. In order to achieve this object, it must be remembered that part of the ration is required to maintain the vital functions of the animal, and it is only the excess of the ration over these maintenance requirements (*viz.*, the energy required for breathing, digestion, circulation of the blood, etc.) which

can be contributed towards production. In the case of the pig, however, no farmer desires to maintain his pigs at a constant weight, but endeavours to produce an increase in weight of 1 lb. per day at least. It is customary, therefore, to include the foods necessary for maintenance in any ration which is fed without specifically referring to it as such.

In considering foods they can be divided into two main divisions:—

1. Water.
2. Dry matter.

1. *Water.*

The water supply for pigs should be clean. Where this supply is contaminated from decomposing organic matter, as in dams, waterholes, swamps or pools, this water may be a prolific source of diarrhoea, dysentery, worms, and other digestive troubles. A plentiful supply of clean water is of particular importance during the summer months when pigs generally drink water to excess as a means of maintaining an equable temperature in their body.

Experiments at the Illinois Experimental Station have shown that fully grown sows weighing 300 lb. may drink up to three gallons of water per day during hot weather. Much, however, depends on the condition of the animal and the time of the year, but the above will indicate the necessity for an ample supply which should be available always.

In evaluating foods, it is desirable that the groups of substances into which the food can be divided, and the use to which these groups are put in the body of the animal, should be known.

2. *Dry Matter.*

The "dry matter" is the fodder after all moisture has been expelled and includes the mineral matter or ash. This dry matter contains all the nutrients from which energy is developed, wear and tear made good, and new tissues built up. In addition, the dry matter supplies bulk to the ration, which is necessary for digestion to proceed normally.

The dry matter of foods is divided into five groups of nutrients, namely:—

(a) Crude protein or nitrogenous material.
(b) Carbohydrates or starchy material.
(c) Fats, oils, etc.
(d) Fibre, which in the case of the pig may be regarded as indigestible.
(e) Ash or mineral matter.

(a) *Protein.*

The protein is an essential nutrient in the support of animal life, and can only be produced in the animal from foods which contain nitrogenous material. Its special use is to produce blood, milk, lean meat, muscles, tendons, nerves, skin, hair, hoofs, and the gelatinous parts of bones, etc.

Remembering that the pig is one of the fastest growing farm animals and lays on meat more rapidly than other stock, the question of the supply of suitable protein or nitrogenous material in the rations is of paramount importance.

(b) *Carbohydrates.*

These substances which contain no nitrogen are the primary source of heat and energy and are associated with foods containing starch, sugar, fibre, etc. In addition to providing heat and energy, they also may be used for laying on fat. They form the bulkiest parts of all foods and are usually comparatively cheap to purchase.

The pig possesses the power to a markedly high degree of converting these carbohydrates into fat in contrast with other farm animals. For this reason, where the public taste now is for lean bacon and pork, and also in Western Australia where the temperature is comparatively high, care should be taken not to increase the carbohydrates in the food beyond the amount required for health.

(c) *Fats and Oils.*

Fats and oils in foods are also energy and heat producers, and, in the case of the pig, exert an influence on the firmness, appearance, and composition of the fatty flesh. Generally speaking, foods containing large quantities of fat or oil such as linseed meal, cocoanut cake, and cotton seed meal, produce a soft fat in the carcase which is undesirable. Fat will provide about 2½ times as much heat per lb. as the carbohydrates, and its quantity, therefore, should be kept as low as possible in the ration.

(d) *Fibre.*

A certain amount of fibre is necessary in all rations, but, as the stomach of the pig is small, the quantity should be limited to approximately 10 per cent. in the case of young pigs, and below this in the case of pigs which have been weaned recently.

Fibre is best supplied in the form of green feed, though, during the summer months in Western Australia, it may be necessary to feed chaffed meadow hay or immature oaten or wheaten chaff in order to provide this roughage.

(e) *Ash or Mineral Matter.*

It is essential that adequate supplies of mineral matter should be available for the growing pig. The minerals which are usually lacking are lime, phosphorus, and chlorine, which, if required, could be provided in the form of bonemeal, slaked lime, di-calcic phosphate, or salt.

As the rations of pigs usually contain a large proportion of grain, which is high in phosphoric acid, lime is usually the element which is lacking.

It is not sufficient, however, to know the chemical composition of foods, which supplies information regarding the relative quantities of each of the five groups of nutrients mentioned above, because the whole of these substances are not available to the animal but only those portions which are digested.

Further, some foods are particularly difficult to digest, and the energy expended in digestion also must be deducted from the food in order to arrive at its true value. A ration containing a high percentage of chaffed wheat straw may be definitely detrimental, as the pig would be unable to digest this roughage, whereas such a ration fed to a ruminant might supply some energy towards the maintenance after the cost of digestion has been deducted.

A considerable amount of work has been carried out by experimental stations in America and Great Britain to discover the net value of various fodders for different types of stock, and these figures are usually those which are utilised in comparing the value of different foods.

The following Table 2 sets out the percentage of digestible nutrients in those foods which probably would be available in Western Australia, and also supplies information regarding the percentage of protein to non-protein matter in each food. This percentage figure is called the nutritive ratio.

Table 2.

FOODS SUITABLE FOR PIGS.

Digestible Nutrients in 100lbs. Dry Matter.

| Foodstuff. | Dry Matter. | Crude Protein. | Starch Equivalent. | Nutritive Ratio, 1 : | Effect on Bacon. |
|---|---|---|---|---|---|
| *Cereal Grains*— | % | % | % | | |
| Barley ... ... ... | 88 | 9·3 | 85 | 8·4 | Very Good. |
| Maize ... ... ... | 87 | 8·4 | 94 | 10·3 | Excellent. |
| Oats ... ... ... | 88 | 8·0 | 71 | 8·3 | Good. |
| Wheat ... ... ... | 88 | 10·2 | 83 | 7·5 | do. |
| *Leguminous Grains*— | | | | | |
| Peas—Field ... ... | 88 | 22·0 | 84 | 2·9 | do. |
| Lupins ... ... ... | 86 | 27·4 | 75 | 2·1 | |
| *Concentrates*— | | | | | |
| Bran ... ... ... | 88 | 14·6 | 54 | 3·6 | Good. |
| Linseed Meal ... ... | 88 | 22·1 | 129 | 5·0 | With care. |
| Meat Meal ... ... | 92 | 65·0 | 100 | 0·62 | Good. |
| Pollard ... ... ... | 88 | 15·5 | 80 | 5·6 | do. |
| Skim Milk ... ... } Butter Milk ... ... } | 10 | 36·0 | 91 | 1·5 | do. |
| *Green Fodders*— | | | | | |
| Lucerne : | | | | | |
| Bud ... ... | 20 | 19·0 | 52 | 2·4 | |
| Full Flower ... | 25 | 14·0 | 42 | 3·0 | |
| Maize ... ... ... | 22 | 5·0 | 57 | 13·0 | |
| Rape ... ... ... | 14 | 17·8 | 58 | 2·9 | |
| Subterranean Clover : | | | | | |
| Young ... ... | 18 | 19·0 | 68 | 2·9 | |
| Hay ... ... | 25 | 10·8 | 44 | 4·4 | |
| Mature ... ... | 90 | 4·5 | 30 | 10·0 | |
| *Potatoes* ... ... ... | 21 | 1·1 | 18 | 16·0 | |

The compounding of rations for pigs is a comparatively simple matter, if it is remembered that the stomach of the pig is small and that substances which would be extremely bulky in order to supply the nutrients required are unsuitable for feeding to pigs.

As a guide, the quantity of grain consumed by a pig is approximately 1 lb. per day for each month of age of the pig, in addition to an ample supply of water. If this weight of food is supplied, then all that is necessary to do is to ensure that the proportion of protein to carbohydrates should be correct.

The following table sets out the nutritive ratio required in rations for pigs of varying weights, which will enable suitable feeds to be supplied:—

Table 3.

NUTRITIVE RATIOS FOR PIGS OF VARYING WEIGHTS.

| | | Protein. | | Carbohydrates. |
|---|---|---|---|---|
| Sows with litters require feed balanced ... ... | | 1 | to | 3·5 |
| Pigs 40 to 100 lbs. ... ... ... } | | 1 | „ | 3·5 to 4·0 |
| 100 „ 150 „ ... ... ... } fattening | | 1 | „ | 4·5 |
| 150 „ 200 „ ... ... ... } | | 1 | „ | 5·0 |
| up to 200 „ 300 „ ... ... ... } | | 1 | „ | 6·5 |
| Boars 300 „ 500 „ ... ... ... ... | | 1 | „ | 5·5 to 6·5 |
| Sows (pregnant) 200 to 350 lbs. ... ... ... ... | | 1 | „ | 5·5 |
| Sows (gilts) 150 „ 300 „ ... ... ... ... | | 1 | „ | 5 |

The following example in calculating a ration to feed six pigs weighing from 100 to 150 lb. each will indicate the use of Tables 2 and 3 above in compounding rations:—

From Table 3 it will be noted that such pigs require a nutritive ratio of 1 : 4.5. The foods which are available are wheat, pollard and skim milk. By referring to Table 2 the compositions of these foods can be ascertained, the calculation then being as follows:—

| | Protein. | Non-Protein Nutrients. |
|---|---|---|
| 100 lbs. Wheat ... ... ... | 10·2 | 76 |
| 50 lbs. Pollard ... ... ... | 7·8 | 43·7 |
| 300 lbs. Skim Milk ... ... | 12·0 | 18 |
| | 30·0 | 137·7 = 1 to 4·6 |

*Another Example.*

| | Protein. | Non-Protein Nutrients. |
|---|---|---|
| 75 lbs. Maize ... ... ... | 6·3 | 64·9 |
| 50 lbs. Pollard ... ... ... | 7·8 | 43·7 |
| 375 lbs. Skim Milk ... ... | 15·0 | 22·5 |
| | 29·1 | 131·1 = 1 to 4·5 |

Either of the above rations, therefore, would be suitable for feeding to pigs weighing 100 to 150 lbs. live weight.

*Quantity of Feed.*

Although usually pigs are fed an amount of ration which they will "clean up" in from 10 to 15 minutes, or, in some cases, are fed through a self-feeder, it is desirable that the farmer should be able to estimate the quantity of any ration which pigs of various weights should receive.

As the various concentrates usually fed are mixed in certain proportions so as to give a nutritive ratio suitable for the type of pigs being fed, it is only necessary for the correct amount of protein to be fed in order to ensure that the pigs are receiving all they require. This simplifies the feeding of pigs considerably in comparison with dairy cows.

The following table sets out the daily quantities of protein which should be fed to pigs of varying weights, and, knowing this figure, it is a simple matter to calculate the pounds of any particular ration required to supply this amount of protein.

PROTEIN REQUIREMENTS OF PIGS.

| Live Weight. | Digestible Protein. |
|---|---|
| lbs. | lbs. per day. |
| 50 | 0·30 |
| 100 | 0·50 |
| 150 | 0·56 |
| 200 | 0·61 |
| 250 | 0·66 |
| 300 | 0·69 |

## GENERAL CONSIDERATIONS.

*Grinding or Soaking Grain.*

Whether the grinding of grain for pigs is profitable is a matter of great economic importance, and the result of experiments now enables definite information to be given. With a large grain such as maize, it is immaterial whether or not the grain is ground, as it is so large that pigs are unable to swallow it without crushing the grain. With small grain, however, such as wheat, barley,

oats, and peas, much of the grain passes through the animal undigested, and grinding or crushing is definitely desirable. The smaller the grain the greater the amount undigested, the saving effected varying from 8 per cent. to as much as 22 per cent. according to the grain used.

Regarding the soaking of small grain, experiments indicate that the soaking of the foods is unnecessary, and it is because of this that self-feeding becomes economically possible. In cold countries pigs are often fed their ration in the form of slops as a means of inducing them to consume greater quantities of water, but, in a climate such as Western Australia, this is unnecessary.

*Cooked Foods.*

Early agriculturists strongly advocated the cooking of food for pigs, but numerous experiments have shown conclusively that, instead of a gain from cooking, there is in nearly every case a loss. In twenty-six trials in America, using corn, barley, rye, peas, either separately or in combination, it was found that there was a loss of approximately 10 per cent. in digestibility through cooking. The only common food in this State which benefits from cooking is the potato.

*Limited Feeding versus Full Feeding.*

One of the most important questions that every pig-raiser has to decide is how much grain he will feed his fattening pigs. It is known that the larger the amount of grain fed, the faster will be the gain in weight, whether the pigs be running on pasture or are sty fed, but there is some doubt whether there would not be more profit if sometimes the amount of concentrates fed were restricted. This is particularly so, as the market demand is for a relatively lean type of carcase.

Several considerations affect the economy of the practice of full feeding. At certain times of the year the prices for pig products are higher than the average, such as during December for the Christmas market, and there is generally a shortage of pigs from March to June, and it may pay to full-feed in order to hasten maturity, so as to obtain the benefits of this higher market.

Experiments conducted in Great Britain and also at Mr. G. W. Burges' farm, "Tipperary," York, last year indicate, however, that full feeding may not only be unprofitable at certain times of the year, but tends to produce an over-fat carcase which is not desired by the trade. In the experiments at York, however, rather than restrict the bulk of ration being fed, the quantity of roughage in the ration was increased, although there is apparently no benefit through increasing this roughage beyond 10 per cent. The roughage utilised should be first quality meadow hay or cereal chaff.

The result of this practice is to delay the period of maturity, but tends to produce a lengthy and leaner type of carcase.

*Home-grown Foods.*

From the previous discussion dealing with meal mixtures and purchased concentrates, it may be inferred that these fodders constitute the main foods for market pigs. A feeder may be able to produce excellent market pigs and yet, at the prevailing price, the result of his operations may be a definite loss. Profits from pigs, as with other types of animal production on the farm, are largely controlled by the ability of the feeder to make the best use of the foods which he finds to hand, or that he can produce on the farm at a low cost. It may be necessary to supplement these home-grown fodders by the purchase of certain concentrates, but the more these former fodders are consumed in proportion to purchased foods the greater will be the ultimate profits.

*Grains.*

*Wheat.*—In Western Australia the principal grain which will be used as a basis for pig-feeding is undoubtedly wheat. Wheat alone, however, is not a complete ration for growing pigs, being low in protein for flesh-building and also lacking in mineral matter for skeleton formation. This grain should predominate in the ration of pigs fed in dry areas, and it has been shown to be possible to produce a good market pig on nothing but crushed wheat, milk or meatmeal and the necessary mineral requirements. While such a limited ration is by no means recommended, it tends to show the possibilities of this grain.

*Barley.*—Barley is a grain which can be grown in the South-West portion of the State and is the equal of wheat for the production of high quality pork or bacon. As with wheat, however, suitable supplements are required.

*Oats.*—In the Dominion of Canada, oats is regarded as the best single grain for market pigs and is said to have a peculiar value in the development of a long and lean carcase. The quality of oats, however, grown in Western Australia is not suitable for forming the bulk of the finishing ration, as pigs do not fill out on this grain but tend to keep in store condition. When feeding oats, quality is essential. Light, shrunken, poorly filled grain is of little value.

*Peas.*—This grain can be grown to advantage throughout the dairying districts of the State and is excellent as forming part of a "topping off" ration—either fed ground or by permitting the pigs to harvest the grain from the field. The quality of bacon from pigs fed on peas is excellent.

Fig. 14.
Sows grazing on pasture at Sabina Vale Stud Farm, Wonnerup.

*Pasture and Green Feeds.*

Pasture undoubtedly may be put to good use on the average farm. During the winter months when pasture growth is at its best, little else is required for growing pigs.

Where pasturing is employed, lucerne and clover are the best crops. Oats or barley, if fed when 6 inches high, give excellent results. Rape is another useful crop and is best suited for pigs from the porker to the bacon stage.

In every instance where pasture is available, pigs will thrive better if some skim milk is available also.

For brood sows and young breeding stock, pasture provides not only the cheapest but the most healthful method of feeding. For pregnant sows, such outdoor conditions prove ideal and little else would be required.

*Roughages and Succulent Foods.*

During the summer months it is impossible on the average farm—unless irrigation is available—to provide green fodder crops for pigs. Experiments have shown that lucerne hay, subterranean clover hay, or early-cut meadow hay are very valuable foods for the brood sow in particular, but also for the market pigs. Such hay should be fed in racks from which the pigs will procure the roughage as required.

Pigs require fibre and will get it in some form or other if only through eating straw or bark of trees. Comparatively little is eaten per head—not more than about ½ lb. per day—and there is ample evidence to the effect that it promotes thrift and health in the pigs.

*Milk Products.*

As a class, these form the most valuable of all pig foods either purchased or home grown. Experience in Canada has shown that, where no milk at all is available and weaners are abruptly removed from the mother to a milkless ration, a low percentage of selected grade hogs usually results. Even a small quantity of milk, however, seems to supply the nutrients that are lacking, and it should be seldom in Western Australia that milk would be entirely impossible to obtain. Meatmeal practically can replace skim milk in the ration. Skim milk and butter milk generally are classed as of equal value.

In evaluating skim milk, 5 lb. of skim milk is equal to 1 lb. of grain in feeding value. Whey may be regarded as of about half the value of skim milk. It is not as valuable as skim milk for young pigs, but fulfils the function of skim milk in pigs of the porker and bacon stage.

The farmer with a home-produced milk by-product at his disposal has the cheapest, safest, most productive, most palatable and surest feed available, and the one item of diet that should ensure the quality and type of the finished baconer.

*Foods that may be Purchased.*

It may not always be possible to feed pigs entirely on home-grown foods. In fact, the greatest returns are seldom obtained by this practice. In Western Australia the purchased grains will be by-products of wheat, barley, or oats. Bran is the most valuable and widely-used wheat by-product for stock generally. It is palatable and peculiarly useful on account of its laxative qualities, and, for this reason, forms a standard food for the brood sow during the fortnight before farrowing when she is usually hand fed. Pollard, however, is more suitable for feeding to fattening pigs and has not the laxative effect of bran, the feeding value of the two being approximately the same.

*Slaughter House By-products.*

On wheat belt areas where skim milk is available only in limited quantities, meatmeal must be purchased as a high protein supplement to the grain ration. It is essential to feed such a supplement in order to reduce the protein ratio of wheat, which is 7.5 to about 4.5, which is that required by growing pigs. The protein ratio of meatmeal is about 1 : 0.62, and for some time this food has been the cheapest form of protein on the West Australian market. This supplement is useful in the ration of pigs of all ages, and, even although not required, is sometimes added in small quantities as a relish to the ration. It

is a useful supplement to the ration of the brood sow, as it gives strength to the piglets in utero and is an insurance against the habit of devouring the newly-born litter. Usually about 5 to 10 per cent. of the meal ration may be made up of meatmeal, the proportion depending on the age of the pigs being fed. (See Table 3.)

*Mineral Supplements.*

Owing to the rapidity of its growth, no domestic animal shows the results of mineral deficiency so rapidly as the pig. There is a heavy call on bone-building constituents, particularly calcium and phosphorus. This deficiency is likely to occur very quickly where pigs are sty fed and have not access to earth. Where lucerne or clover grazing is available, or these crops are fed as good quality hay, there is not likely to be a deficiency of either of these minerals. Charcoal is relished by pigs and has absorbent and digestive qualities which keep the organs in a healthy condition. From time to time also, particularly with sty fed pigs, a little salt should be included in the ration.

Where meatmeal is being fed, there is not likely to be a deficiency of phosphorus, but as the other portion of the ration will be mainly wheat or a similar grain, there may be a deficiency of lime, which can be supplied by an addition of 1 to 2 per cent. of ground limestone or bonemeal to the ration.

RELATIVE FOOD VALUES OF CONCENTRATES.

PERTH, DECEMBER, 1936.

| Foodstuff. | Cost. | Cost per 100lb. | Starch Equivalent per 100lb. | Digestible Protein per 100lb. | Cost per 1lb. Starch Equivalent. | Cost per 1lb. Digestible Protein. |
|---|---|---|---|---|---|---|
| | | s. d. | lb. | lb. | d. | d. |
| Wheat ... ... | 5s. 6d. per bushel of 60lb. | 9 2 | 83 | 10·2 | 1·33 | 10·78 |
| Oats ... ... | 3s. 2d. per bushel of 40lb. | 7 11 | 71 | 8·0 | 1·34 | 11·88 |
| Bran ... ... | £7 10s. per ton ... | 7 6 | 54 | 14·6 | 1·67 | 6·16 |
| Pollard ... | £7 10s. per ton ... | 7 6 | 80 | 15·5 | 1·12 | 5·81 |
| Linseed Meal ... | £12 10s. per ton ... | 12 6 | 80 | 29·0 | 1·88 | 5·17 |
| Meat Meal (W.A.) | 13s. per 100lb. ... | 13 0 | 100 | 65·0 | 1·56 | 2·40 |
| Peas ... ... | Unobtainable ... | ... | ... | ... | ... | ... |
| Young Subterranean Clover Pasture* | 20s. per ton ... | 1 0 | 65 | 19·0 | 0·19 | 0·63 |
| Subterranean Clover Silage | 10s. per ton ... | 0 6 | 43 | 9·4 | 0·14 | 0·64 |

* Dry matter.

The above table shows that for the supply of energy or fat-forming foods, among the grains, wheat, oats and pollard are approximately the same value, pollard being slightly cheaper than the other two.

The cheapest source of protein or flesh-forming food, apart from pasture and silage, is meatmeal. Protein in meatmeal is approximately half the cost of that contained in linseed meal.

No purchased concentrate, however, can compete with young clover pasture or clover silage in economy of production.

## FEEDING PIGS IN THE WHEAT BELT.

The basic foods which will be available in dry areas are wheat, barley, and oats, depending on the district in which pigs have to be fed. Probably no single fact in stock feeding has been more clearly demonstrated by numerous feeding

trials than that maize, wheat, and other cereal grains alone give exceedingly poor results when fed to growing and fattening pigs.

The following table summarises the results of seven trials in which maize alone was fed to young pigs, averaging 69 lb. in weight, in comparison with another group of pigs where meatmeal was added to the maize ration. The results also are given for 15 similar comparisons of *maize alone versus maize and meatmeal* for older pigs averaging 184 lbs. in weight when the experiment began.

Table 4.

MAIZE ALONE *VERSUS* MAIZE AND MEATMEAL.

| Average Ration. | Length of Trial. days. | Daily Gain. lbs. | Feed for 100lbs. Gain. Maize. lbs. | Feed for 100lbs. Gain. Meatmeal. lbs. |
|---|---|---|---|---|
| With Young Pigs— | | | | |
| (1) Maize alone, 3·5lbs. ... ... | 122 | 0·59 | 642 | ... |
| (2) Maize, 4·4lbs. ... ... ... Meatmeal, 0·48lbs. ... ... | 122 | 1·18 | 387 | 42 |
| With Older Pigs— | | | | |
| (1) Maize alone, 5·7lbs. ... ... | 69 | 1·03 | 617 | ... |
| (2) Maize, 6·1lbs. ... ... ... Meatmeal, 0·67lbs. ... ... | 66 | 1·59 | 400 | 43 |

It will be seen that the younger pigs gained only 0.59 lb. per head daily and required 642 lb. maize for each 100 lb. gain. Where meatmeal was added the gains were practically double, and only 387 lb. maize were consumed for each 100 lb. gain.

Similar results were obtained with the older pigs, although, as might be expected, this group did not show the effect of the omission of the meatmeal so seriously as in the younger pigs.

In numerous experiments where wheat and maize have been fed in comparison, it has been shown that their value is similar, wheat being slightly superior.

From the above, the folly of feeding such an unbalanced ration as maize or wheat alone will be realised, and yet there is ample evidence at various sales that pigs are being fed on such a ration, which produces short, stumpy, and very fat pigs.

Some *roughage* also is necessary which, in the winter time, can be supplied by grazing, and, in the summer time, from the use of good cereal chaff or meadow hay, mixing about 10 per cent. with the grain ration.

Shrunken wheat that has been injured by drought or frost before maturity can be economically fed to pigs, although it may be unsuited for milling and would realise a low price. Such wheat is usually richer in protein than wheat of good milling quality, and, if not excessively immature before the check in growth occurs, may be equal in feeding value to sound wheat.

Inquiry is sometimes received regarding the value of pickled wheat for feeding to pigs. This depends on the chemical used for pickling. In the case of Formalin, the wheat should not be fed to stock. In the case of Copper Carbonate, provided the wheat has been thoroughly soaked in two changes of water, there will be little danger from feeding to pigs, as the Carbonate is dissolved in the water.

Wheat or other grains always should be ground or crushed before feeding, the saving in the case of wheat being from 16 per cent. to 22 per cent. Soaking wheat is a poor substitute for grinding, as it makes little saving over feeding the grain dry.

Barley may be regarded as approximately the same value as wheat for feeding to pigs and should be treated in a similar manner.

Good feed oats, when used to replace barley or wheat, should be regarded as worth about three-fourths the value of these two grains.

In feeding trials in America and Great Britain, it has been found that approximately 4.4 lb. of wheat is required to produce 1 lb. of bacon. Feeding trials in Queensland and at "Tipperary," York, Western Australia, have shown that a lesser quantity than this is required, namely, from 3.6 to 3.9 lbs. to produce 1 lb. of bacon. This is due probably to the warmer climatic conditions which would reduce the food required for maintenance as compared with that in colder countries.

The following ration is one that has given good results and is recommended for use in wheat producing areas:—

| | |
|---|---|
| Crushed Wheat or Barley .. .. .. .. | 80 parts |
| Meatmeal—60 per cent. Protein .. .. .. | 9 „ |
| Good Oaten Chaff .. .. .. .. .. | 10 „ |
| Ground Limestone .. .. .. .. .. | 1 „ |

Pigs should be fed as much of the above ration as they will "clean up" in about 10 to 15 minutes twice per day, which, under ordinary conditions, will be found to approximate 1 lb. per day for each month of age of the pig.

In dry areas it is essential that ample shade and water should be available always. It is not necessary to erect expensive shelters, a cheap shelter, being that illustrated, which is made of posts and wire netting about four feet from the ground on which 9 to 12 inches of straw has been placed. This may be destroyed at the end of the season if thought fit.

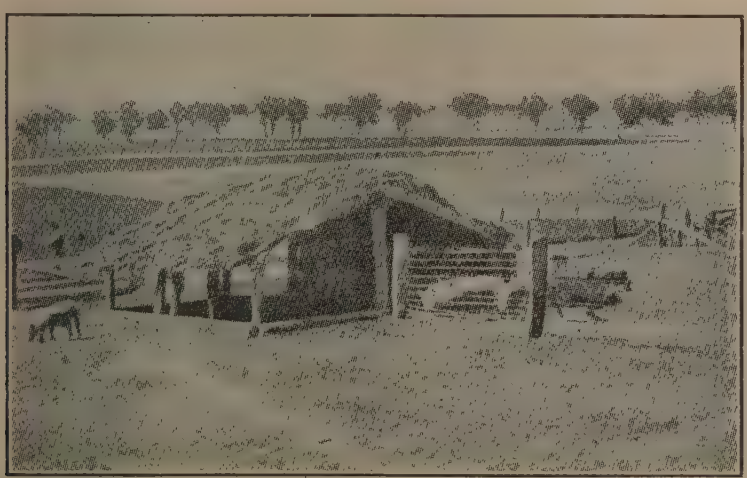

Fig. 15.
Cheap shelter suitable for wheat belt conditions. Water troughs also could be covered in this manner.

## PORK OR BACON.

The most profitable period for the feeding of pigs is from the time they are about 80 lb. live weight up to bacon stage, i.e., about 170 lb. live weight.

In order that pork production should be profitable, it is necessary that a higher price per lb. should be received for this carcase. The difference between pork and bacon prices—in order for pork to be profitable—will vary with the price of grain. As a guide: With wheat at 3s. per bushel, pork should be 1½d.

per lb. more than bacon to be profitable. With wheat at 3s. 6d. per bushel, pork should be 1¼d. more. With wheat at 4s. per bushel, pork should be at least 1d. per lb. more.

It is only for short periods each year on the local market that these differential prices obtain. During 1934-35 this profitable difference in favour of pork only existed during nine weeks of the 52, and six of these weeks were immediately prior to Christmas.

Generally speaking, farmers situated any distance from the metropolitan area would be well advised to aim at bacon production rather than pork.

## VALUE OF WHEAT FOR BACON PRODUCTION.

The following table shows the value of wheat at varying prices when used for feeding pigs. The ration used as a basis of the calculation is that recommended above.

Table 5.

EFFECT OF BACON PRICES ON VALUE OF WHEAT FOR FATTENING PIGS.

| Bacon Prices, per lb. | Value of Carcase, 120lbs. | Nett Return after deducting Cost all Feeds except Wheat. | Value of Wheat per bush. |
|---|---|---|---|
| s. d. | s. d. | s. d. | s. d. |
| 0 7 | 70 0 | 60 4 | 7 6½ |
| 0 6½ | 65 0 | 55 4 | 6 11 |
| 0 6 | 60 0 | 50 4 | 6 3½ |
| 0 5½ | 55 0 | 45 4 | 5 8 |
| 0 5 | 50 0 | 40 4 | 5 0½ |
| 0 4½ | 45 0 | 35 4 | 4 5 |
| 0 4 | 40 0 | 30 4 | 3 9½ |

## FEEDING PIGS IN THE DAIRYING DISTRICTS.

The by-products on dairy farms, which are difficult to utilise unless fed to pigs, will consist of skim milk and—where farmers are close to factories—butter milk and whey. These products are specially valuable by reason of the character of the protein which they contain and also its high digestibility, which is practically 100 per cent. These products are also rich in mineral matter, especially in lime and phosphorus, which are the chief minerals forming the skeleton.

It has been claimed that fat soluble vitamin has been removed from skim milk, butter milk and whey, and for this reason, if any of these by-products are fed with a grain low in this vitamin, such as white maize, it may result in poor returns. This deficiency, however, is cheaply supplied by making lucerne or clover available to the pigs either in the form of grazing or as hay.

In arriving at a feeding value for skim milk, this food should be compared with the most efficient commercial substitute, which is meatmeal. No progressive farmer would attempt to feed pigs on such an inefficient ration as grain alone when they are not on clover pasture.

The following table shows the comparative value of skim milk and meatmeal as a supplement to maize for fattening pigs, and, as mentioned before, wheat or barley is comparable to maize, but slightly superior for this purpose.

Table 6.

SKIM MILK *VERSUS* MEATMEAL AS A SUPPLEMENT TO MAIZE

| Average Ration. | Daily Gain. | Feed for 100 lbs. Gain. | | |
|---|---|---|---|---|
| | | Maize. | Skim Milk. | Meatmeal. |
| | lbs. | lbs. | lbs. | lbs. |
| (1) Skim Milk, 7·1 lbs. ... ... Maize, 4·6 lbs. ... ... ... | 1·36 | 346 | 535 | ... |
| (2) Meatmeal, 0·47 lbs. ... ... Maize, 4·90 lbs. ... ... ... | 1·24 | 404 | ... | 39 |

These trials, which are the average of 12, show that skim milk is slightly superior to meatmeal for supplementing grain.

For feeding to young pigs before and soon after weaning, skim milk is best if fed fresh, although even for young pigs, as long as souring is effected under sanitary conditions, results are satisfactory. If, however, sour milk must be used, it always should be fed sour. Feeding sweet milk at one period and sour at the next is apt to cause scours.

## MONEY VALUE OF SKIM MILK.

Feeding trials have shown that 100 lb. of skim milk can replace in the ration approximately 11 lb. of wheat and 7.25 lb. of meatmeal, and its money value, therefore, with wheat and meatmeal at various prices, may be readily computed. Butter milk also may be regarded as equal in feeding value to skim milk.

In considering these values, however, it should be borne in mind that they are only true when no more milk is fed than is needed to balance the ration. If greater quantities of skim milk are provided than necessary for this purpose, the extra amount consumed is converted into fat and not into lean meat, the nitrogenous portion being lost in the excreta. It is, therefore, uneconomic to feed skim milk or butter milk alone.

Table 7.

MONEY VALUE OF SKIM MILK OR BUTTER MILK PER GALLON FOR PIGS.

| Value of 1 gallon Skim Milk or Butter Milk— | Price of Wheat per Bushel. 3s. 0d. | 3s. 6d. | 4s. 0d. | 4s. 6d. | 5s. 0d. | 5s. 6d. |
|---|---|---|---|---|---|---|
| | d. | d. | d. | d. | d. | d. |
| With Meatmeal at £12 per Short Ton | 1·70 | 1·81 | 1·92 | 2·03 | 2·14 | 2·25 |
| " " " £13 " " | 1·79 | 1·90 | 2·01 | 2·12 | 2·23 | 2·34 |
| " " " £14 " " | 1·88 | 1·99 | 2·10 | 2·21 | 2·32 | 2·43 |
| " " " £15 " " | 1·96 | 2·07 | 2·18 | 2·29 | 2·40 | 2·51 |
| " " " £16 " " | 2·05 | 2·16 | 2·27 | 2·38 | 2·49 | 2·60 |
| " " " £17 " " | 2·14 | 2·25 | 2·36 | 2·47 | 2·58 | 2·69 |

Meatmeal, £14 per ton ; Oaten Chaff, £3 per ton on farm.

When the supply of skim milk is low, it is not necessary to feed more than 3 to 4 lb. for every 1 lb. of grain consumed, but, under average conditions, from 6 to 10 lb. of skim milk for every 1 lb. of grain will give satisfactory results, the greater quantity of milk being used when feeding the younger pigs.

## WHEY.

Whey is relatively low in protein, as the casein of the milk is removed in cheese-making. Because of this, its nutritive ratio is 1 : 6.8 in comparison with 1 : 1.5 in the case of skim milk. Owing to this low content of protein whey is sometimes overlooked as a supplement to cereal grains.

Feeding trials, however, have shown that whey is of considerable value when fed with certain grains for fattening pigs. When fed with barley, surprising results have been obtained where about 3 lb. of whey per lb. of barley forms the ration, gains of as much as 2.2 lb. per day being obtained. This was in spite of the fact that the ration had a nutritive ratio of 1 : 7.4. These results apparently are due to the fact that, while whey is low in protein, what it does contain—which is chiefly milk albumin—is of excellent quality to serve as a supplement to the proteins of cereals.

These pigs were approximately 125 lb. live weight when feeding commenced. With younger pigs it is found necessary to add some protein rich food, such as meatmeal, or linseed meal, in order to balance the ration. About 1 lb. of meatmeal or 3 lb. of linseed meal should be added to the ration for every 10 gallons of whey.

Fig. 16.

Skim Milk made the Difference.

These two pigs are of the same age, from the same litter, were both weaned from mother at six weeks old, and were both fed as much ground oats, ground barley, and ground corn as they would eat. They were kept in the same feed barns and were cared for by the same persons, the only difference being that the larger one received milk and the smaller one had no milk. The pig receiving no milk is not only smaller but he has a poor coat, has scurvy, and is in every way a poor specimen.

## SUPPLEMENTS TO SKIM MILK IN DAIRYING DISTRICTS.

In these districts one of the greatest advantages over the dry areas is the ability to supply good grazing or green fodder crops during the greater portion of the year. Where lucerne or clover can be supplied in the form of grazing, about 4 to 5 inches high, little else is required beyond skim milk in order to ensure rapid growth until about one month from bacon weight. Such pigs, however, if forwarded to the market without being "topped off" with some grain, do not dress out economically, and the quality of the fat is inferior. The pigs are described in the trade as being "soft." In order to overcome this, it is essential that grain in one form or another should be supplied. It is not necessary to confine the pigs to sties in order to do this, as the grain may be fed either by hand twice a day—usually at the same time as the skim milk—or self-feeders may be placed in the paddocks where the pigs to be "topped off" are grazing. It is uneconomical to self-feed the growing pigs or sows, so that several small pig paddocks are required for efficient management.

In order to obtain the best returns, an effort should be made to provide the grain from home-grown produce. Barley or peas can be grown successfully, and it should be possible in many areas for either maize or a mixture of maize and cow peas to be grown and allowed to ripen, so that pigs may be "topped off" in the field. Where peas are being grown, as the nutritive ratio

of peas is 1 : 2.6, it is uneconomical to feed peas alone or to graze peas. It generally will be found profitable to purchase wheat, barley, or pollard to be fed in conjunction with the peas, equal quantities of each forming the ration with skim milk as before.

At certain times of the year potatoes may be available and would be suitable for feeding with peas, as potatoes are very low in protein, their ratio being wide, 1 : 11.

Four to 5 lb. of potatoes are the equivalent of 1 lb. of grain.

A mixture such as maize and cow peas, if sown early in the summer, should ripen within 4 to 5 months and may then be harvested by the pigs themselves, from which a complete ration could be obtained.

The importance of grazing in conjunction with feeding in the dairying districts, however, should not be overlooked, as the saving in grain, where good grazing is available, varies from 10 to 15 per cent., and the supply of grain is the expensive portion of the ration in these districts.

Fig. 17.
Cow Peas and Maize, S. F. Russell, "Wendowie," Serpentine.

## SELF-FEEDING.

There is now no doubt that permitting pigs to feed themselves from supplies of rations, either separately or ready mixed, is not only economical but ensures a great saving in labour. The system of self-feeding gives excellent results with *growing fattening* pigs, or with old sows which are to be fattened.

The self-feeder should not be used when rapid gains are not required, or for growing pigs for the breeding herd, or for pregnant sows, unless some bulky food such as clover chaff or good oaten chaff is mixed with the grain. For such pigs, however, hand-feeding would be preferable.

The following table shows the results of 17 trials of hand-feeding pigs in comparison with self-feeding. It will be seen that the self-fed pigs grow a little more rapidly than the hand-fed pigs and consume rather less of the ration for each 100 lb. gain in weight. In these trials the pigs had no pasture available, but similar results were obtained in other trials where pasture was available.

Table 8.

SELF-FEEDING *VERSUS* HAND-FEEDING.

Without Pasture. 314 Pigs—Average weight, 86 lbs.

| | Daily Gain. | Feed for 100lbs. Gain. | | |
|---|---|---|---|---|
| | | Maize. | Meatmeal. | Total. |
| | lbs. | lbs. | lbs. | lbs. |
| (1) Self-Fed ... ... ... ... | 1·58 | 359 | 56 | 415 |
| (2) Hand-Fed, twice per day all that would clean up | 1·42 | 356 | 68 | 424 |

Similar results were obtained where pasture was available.

It is immaterial whether the ration be mixed and all fed through the one self-feeder, or whether a number of self-feeders are used, each containing a separate ingredient of the ration. The pigs apparently will eat the various proportions as required in order to give maximum growth. It is usual, however, to mix the ration where more than one grain is being used, and also the meat-meal may be mixed with the grain ration without any physical inconvenience in feeding.

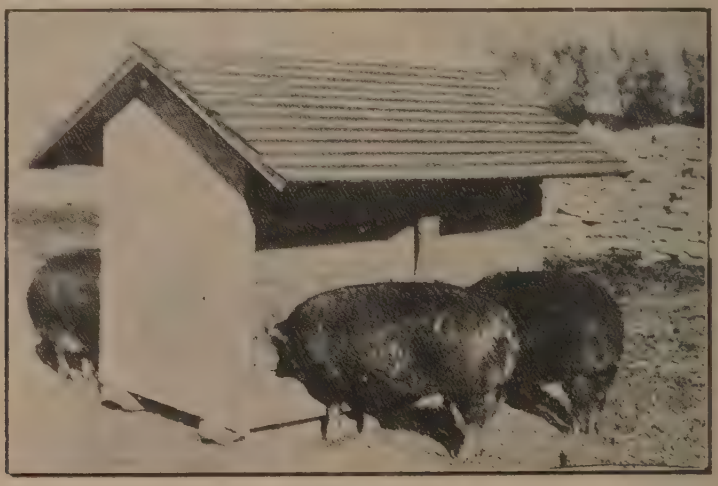

Fig. 18.
The Self-Feeder working.

It is necessary to inspect the feeder at frequent intervals to see that the troughs are clean and that a free flow of food is available from the hopper. The feeder should be located on a dry area of land and, if possible, mounted on skids so that it can be removed to a clean place when necessary.

The following are details of a self-feeder which has given excellent results in Canada and in Australia and is suitable for feeding from 15 to 20 pigs.

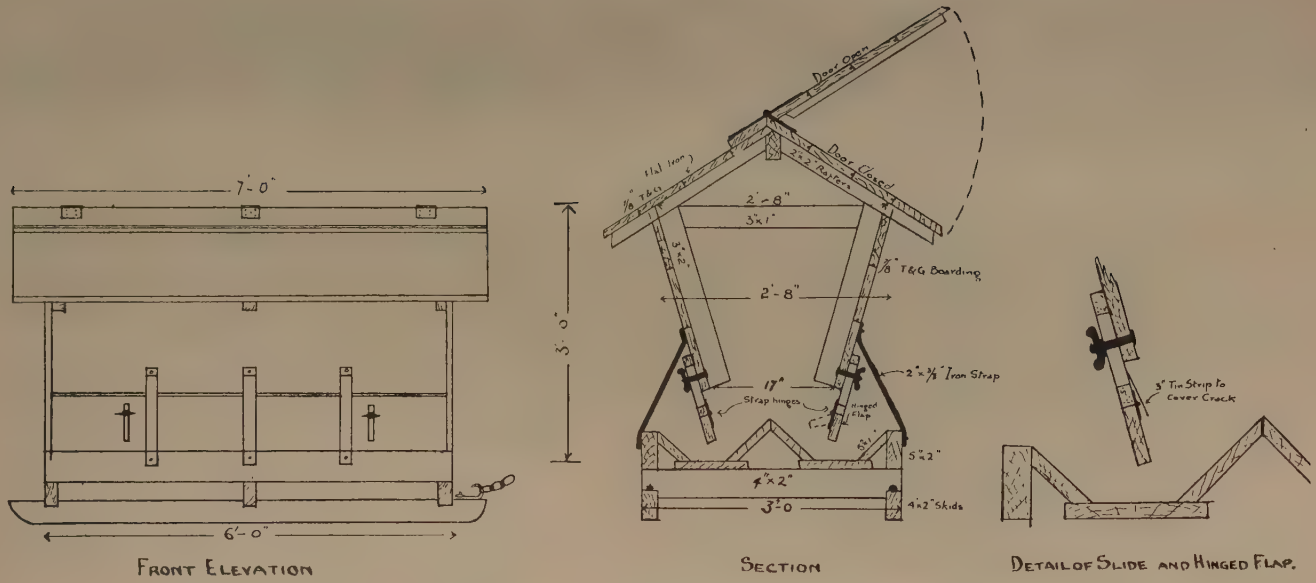


Fig. 19.

Details of Self-Feeder described on page 566.

## CONSTRUCTION OF SELF-FEEDER.

1. *The Feed Trough.*

The self-feeder rests on two 4in. x 2in. skids provided with two strong flat iron draught lugs, which render it portable.

Three 4in. x 2in. bearers are then notched over the skids. On top of these bearers the feed trough is formed, the bottom being 10in. x 1in., and the sides 5in. x 2in. on edge bolted to bearers with ⅜in. bolts through the skids and bearers. Two pieces of 8in. x 1in. wood placed at 45 degrees form the centre or back of both troughs, and two pieces of 5in. x 1in. wood placed at 45 degrees from the 5in. x 2in. side-pieces to the bottom board complete the feed trough.

2. *The Bin.*

The bin, or hopper, is constructed of wood. The frame is made of 3in. x 2in. uprights with 3in. x 1in. across the top; rafters of 2in. x 2in. and 4in. x 2in. ridge. The top is sheathed with 6in. x ⅞in. tongue and grooved boards; one side of the top acts as the door, which is composed of 6in. x ⅞in. tongue and grooved boards with two 6in. x 1in. ledges. The door and top are covered with flat iron; hinge door with three strap hinges.

The top should project well over the trough, so that water will not drip into it. The sides and end of the bin should be sheathed with 6in. x ⅞in. tongue and grooved boards. The bin is supported by 2in. x ⅜in. iron straps bolted to trough and to bin.

The slide and hinged flap are regulated with a slot and bolt and screw; the bottom of the slide is hinged with strap hinges. The slide is 8in. x 1in. wood, the flat 4in. x 1in. wood, with a strip of tin or light iron 3in. wide to cover the crack.

The whole structure measures 6 feet long by 3 feet wide, the eaves projecting 6 inches all around.

## DISEASES OF PIGS.

Healthy pigs should have a voracious appetite and show a continuous increase in weight, an active vigorous appearance, easy movement, grunting, head down, tail curled, bright eyes, moist snout, bright skin, and regular breathing. Their normal temperature is about 103 deg. Fahr. and 10 to 20 respirations per minute. The pulse taken on an artery inside the fore-leg averages 70 to 80 per minute.

Any divergency should be specially noted, the best time for seeing this being when the animals are fed. Feeding, therefore, should be done by the owner or by an employee who can be trusted and has interest in the work. The pig may fail to rush the pig trough with its mates, preferring isolation in the sty or in another portion of the field. Breathing may be affected, accompanied by a cough with hurried panting. The temperature may rise above normal, and the pulsation become rapid. The nostrils may become dry and frequently discharge. The skin becomes dry and hard-looking in appearance. The character of the dung is also an indication of approaching disease.

*To be continued.*

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